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THE GULF STREAM.*

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In coming here this afternoon to read a paper on the Gulf Stream, I am fulfilling a rather long-standing engagement. Before commencing the preparation of my contribution, I felt considerable doubt as to what special points, in a somewhat well-worn subject, it would be suitable for me to direct attention. Finally I decided to draw up a brief account of the origin and course of the Stream, and to supplement this statement by a reference to an investigation that has been undertaken in the Meteorological Office bearing on the relation of sea surface temperature of the North Atlantic to air temperature over our Islands.

Much of what I say will not be new to the majority of those present, who presumably are students of oceanography, and some of the conclusions I draw, which are not in accord with accepted theories, will doubtless invite discussion. On occasions like the present the opinions evoked in discussion frequently prove to be those of the most interest and of the greatest value; I shall feel contented if this be the case at our meeting here this afternoon.

In the Atlantic, Indian, and Pacific oceans, over whatever regions the trade winds circulate the surface of the water over and upon which they blow is impelled in about the same direction as the breeze, with a velocity that depends upon the impetus the water has already received, and the strength of the air-current which prevails at the time.

The strength of a trade wind varies geographically, seasonally, and at the same time irregularly; from that of a light breeze, which is just sufficient wind for "working" a sailing vessel, to that of a gale, in which a considerable reduction of sail becomes necessary, even when the vessel is

* Royal Geographical Society, May 21, 1914.

running with the wind aft or on her quarter. As a rule, however, the strength of a trade wind does not much exceed that which by experience

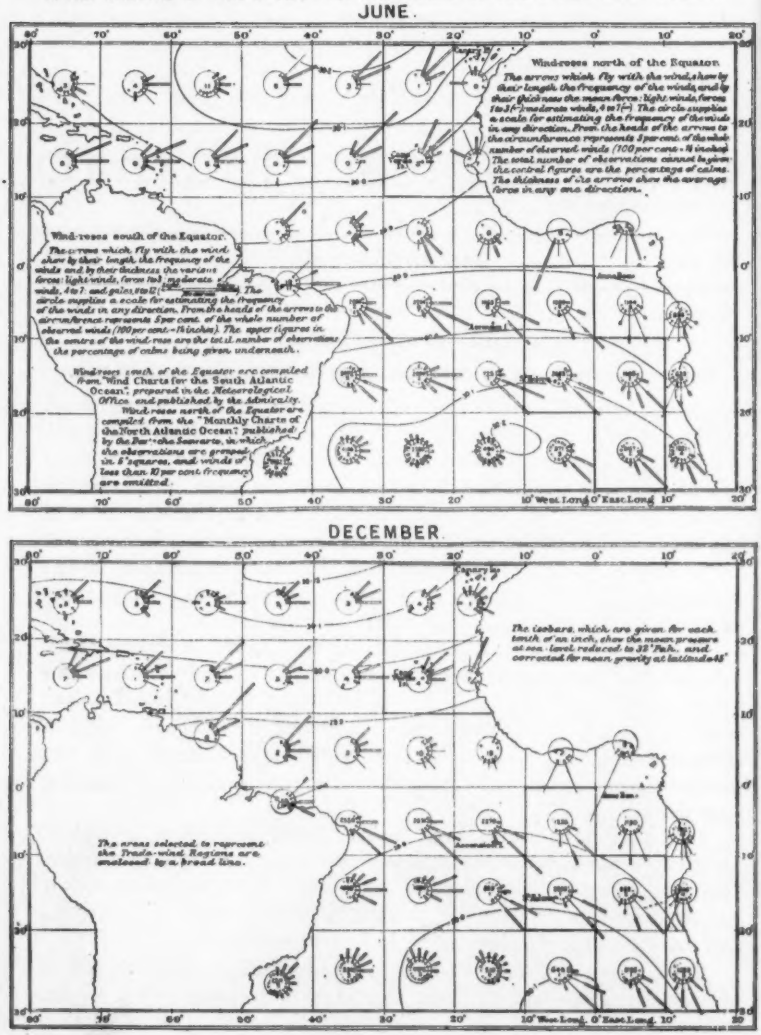
WIND CHARTS OF THE INTERTROPICAL BELT OF THE ATLANTIC OCEAN.
JUNE.
Wind-roses north of the Equator.
Wind-roses south of the Equator.
DECEMBER
The isobars, which are given for each tenth of an inch, show the mean pressure at sea-level reduced to 32° Fah., and corrected for mean gravity at latitude 45°
The areas selected to represent the Trade-wind Regions are enclosed by a broad line.

FIG. 1.

has been found most advantageous for sailing when it is a "leading wind" and all sail is drawing. This is called a "moderate breeze."

As regards the Atlantic, the expanses over which the north-east and south-east trade winds blow are fairly well represented by the areas to which they are confined in the months of June and December respectively; the former being for the most part characteristic of the six months October to March, the latter to the six months April to September (Fig. 1).*

In June the north-east trade wind commences in about 35° N., and cannot be said to extend farther south than the 10th to the 5th parallel of north latitude, where the "doldrums" intervene. Moreover, east of the 40th meridian the wind turns to the eastward, south-eastward, and southward, south of the 10th parallel. The south-east trade wind in this month commences in about the 30th parallel of south latitude, and extends to nearly 5° N.; except south of a line drawn between 30° S., 5° E. and Bahia, in Brazil, where it becomes easterly to northerly or variable. Also off the Guinea Coast, where it is southerly to south-westerly (monsonal).

In December the north-east trade wind prevails roughly from about 30° N. to about 5° N.; between the Guinea Coast and the latter, where the "doldrums" intervene, it becomes variable or southerly. The south-east trade wind in December commences in about the 35th parallel of south latitude between the 10th meridian of west longitude and the African coast; and is experienced to the north and north-west as far as 2° N. except south of a line from a position in 35° S., on the meridian of Greenwich, to Cape St. Roque on the coast of Brazil, where the wind turns to the eastward, and north-eastward.

The currents set up by these steady winds are slight, confined to the surface, and intermittent in the higher latitudes in which they prevail; but they gain in strength, volume, and constancy as they flow towards the equator to form part of that mighty ocean stream, the Equatorial Current.

Although the trade winds must be regarded as the prime agents in the production of the currents over which they blow, yet the true places of origin of the Equatorial Current are to be found in higher latitudes than those in which the former commence (Fig. 2).

In the northern hemisphere a southerly current is experienced on the eastern side of the ocean, from about the 45th parallel between about the 25th meridian of west longitude and the land; but in some months still farther north, which is the true commencement of the southward-flowing current. This current is derived partly from a surface drift due to the northerly winds that are of frequent occurrence between the 10th and 20th meridians during the greater part of the year (March to September inclusive), partly from the easterly and north-easterly branches of the Gulf Stream.

Similarly, in the southern hemisphere a northerly current is experienced on the eastern side of the ocean, between the Greenwich meridian or thereabouts and the 20th meridian of east longitude south of Cape Point, but

* From 'The Trade Winds of the Atlantic Ocean.' Published by the authority of the Meteorological Committee, 1910.

off the land north of that point, which is the actual commencement of the northward-flowing current. It is derived partly from the easterly surface drift set up, and maintained by the westerly winds of the Southern ocean, the northern edge of which turns northward on the eastern side of the ocean; partly from a current of polar origin which mingles with the former

MONTHLY CURRENT CHARTS—ATLANTIC OCEAN.
APRIL.

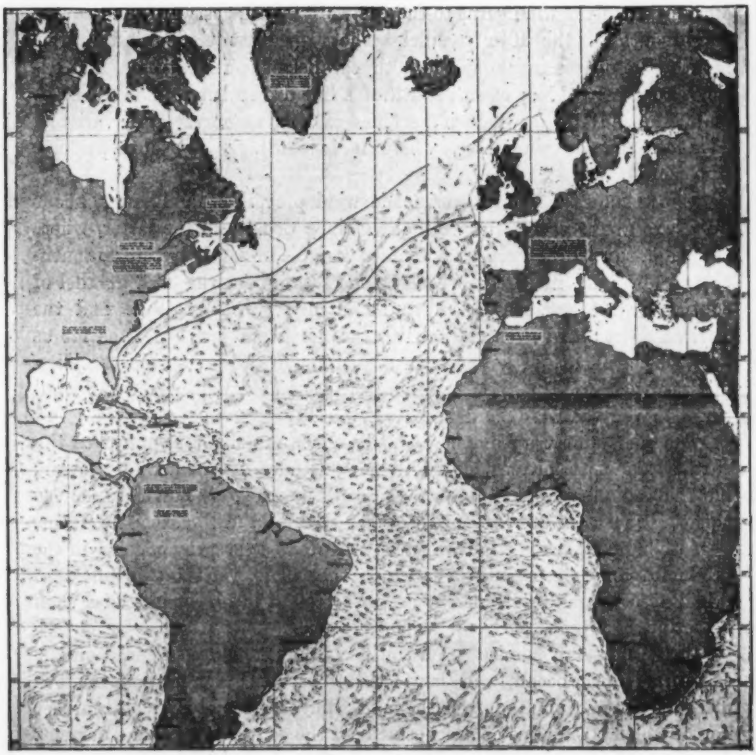

FIG. 2.—THE COURSE OF THE GULF STREAM NORTH-EASTWARD IS INDICATED BY THE FINE LINES, WHICH DEFINE ITS NORTHERN AND SOUTHERN BOUNDARIES.

and continues its course far to the northward along the shores of South-West Africa; and partly, but in a much smaller measure, from the Agulhas or Mozambique Current that flows southward off the east coast of Africa, a branch of which rounds Cape Point. This combined flow to the northward is sometimes called the "Benguela Current."

Many theories have been advanced to account for ocean currents in

general and for the Gulf Stream in particular. Their causation has been attributed by various writers to—

Differences in the temperature and density of the sea in widely separated geographical positions.

Differences in level due to inequalities in different regions of evaporation and precipitation; and to the outflow of great rivers. To the rotation of the Earth on its axis; and to the direct action of persistent winds. To convection currents.

The speculations as to the cause of the Gulf Stream that have been promulgated from time to time, and the facts which have been marshalled to disprove them, are clearly set out in A. G. Findlay's 'North Atlantic Ocean.'

It has been suggested that the outflow into the Gulf of Mexico from the river Mississippi and from other great rivers in flood, raises the level of the gulf sufficiently to account for the torrent through the Strait of Florida that imparts to the stream much of its energy. In refutation of this hypothesis it was pointed out that the Mississippi does not contribute a three-thousandth part of the volume of the Gulf Stream; and Lieutenant-Commander J. E. Pillsbury, of the United States Navy, whose important investigations bearing upon the course, velocity and volume of the stream, near the coast of America, conducted when in command of the U.S. steamer *Blake*, entitles him to be regarded as the greatest authority upon the subject, goes so far as to say on this point, that in actual fact about 2000 such rivers as the Mississippi would be required to produce the effect.

Another proposition that has found advocates is the effect of temperature. The necessary head of water, it has been contended, is generated in the gulf by the expansion of the water due to the increase of heat in this locality as well as in the Equatorial Current from which the stream is derived. The refutation of this explanation by Sir John Herschel is quoted by Findlay as follows: "Let us see what this declivity found by unequal temperature would amount to. The equatorial surface water has a temperature of 84° Fahr.; at 7200 feet the temperature is 39° Fahr., the level of which temperature rises to the surface in latitude 56°. Taking the dilatability of sea-water to be the same as fresh, a uniformly progressive increase of temperature from 39° to 84° would dilate a column of 7200 feet by 10 feet (or 9·971 feet more exactly), to which height, therefore, above the spheroid of equilibrium (or above the sea-level in 56°) the equatorial surface is actually raised by this dilation. An arc of 56° on the Earth's surface measures 3360 geographical miles, so that (were the water to run direct north) we have a slope of one twenty-eighth part of an inch per mile for the water so raised to run down. As the accelerating force corresponding to such a slope (of one-tenth of a second, 0·1″ of arc) is less than two-millionth part of gravity, we may dismiss this as a cause capable of creating only a very trifling surface drift, not worth considering,

even were it the proper direction to form, by concentration, a current from east to west; which it would not be, but the very reverse."

Commander Pillsbury, basing his disproval of the unequal temperature theory on a similar argument, assumed the temperature of the Atlantic in the vicinity of the equator at a depth of about 1000 fathoms (6000 feet) to be 37° Fahr., below which the changes are slight to the bottom, while at the surface it is not far from 80°. He estimated the expansion of water due to this change in temperature to be about 0·005, equivalent to 30 feet for a column of 1000 fathoms, which would imply a gradient between the equator and the pole of about 0·06 inch to a mile; an infinitesimal difference.

Other writers have attributed the cause of the Gulf Stream to inequalities of evaporation and precipitation over the Atlantic, unmindful of the fact that the region of maximum evaporation is over the trade wind area, and the region of maximum precipitation in the neighbourhood of the equator towards which the trade-wind currents, which feed the great Equatorial Current, flow.

Wind is the prime cause of all currents; persistent winds the motive power to which all the great ocean streams may be assigned. If any one be in doubt as to the fact, let him place tracings of maps on which the direction of the principal currents of the globe in the different months or seasons of the year are indicated over maps on the same scale on which wind distribution, referable to the same months or seasons, is shown; and it will be seen how closely the currents follow the direction of the wind, and how quickly the former respond to changes in the direction of the latter.

In this connection the course of the Equatorial Current of the Indian ocean, on the western side of the Arabian sea, may be cited as a striking example. During those months in which the north-east monsoon prevails the current in that region turns to the southward and joins the Mozambique Current, but as soon as the change in the direction of the wind occurs, and even before the south-west monsoon is established, the current swings round and flows in the new direction of the wind, to the northward and eastward.

All winds by friction cause some movement of the water surfaces over which they blow, while the waves, and wavelets they raise, add impulse to the motion; the stronger the wind the greater being its effect at the time. This surface movement caused by wind is gradually imparted to the water layer below it, and when the wind persists in the same direction for long this motion is transmitted from layer to layer to a considerable depth.

Under the influence of the trade winds, the currents when nearing equatorial regions probably extend to a depth of from 200 to 400 feet.

Although the principal currents are produced and maintained by the action of persistent winds, their direction is largely controlled by the

rotation of the Earth on its axis and by variation in temperature and in density, also in evaporation and precipitation in different geographical positions, but these exert only slight local modifying effects. Moreover, as regards the Gulf Stream, and its causation, it was found by the officers of the United States Coast Survey that the Atlantic ocean at Sandy Hook was 3 to 4 feet lower than the waters of the Gulf of Mexico at the mouth of the Mississippi. This difference of level, which is said to have been ascertained by accurate measurements, doubtless is caused by the heaping up of water in the gulf by the Equatorial Current; and the power requisite for maintaining the constant flow of the Gulf Stream through the Strait of Florida and to the northward must in a large measure be attributed to this agency.

The north-east and south-east trade winds drift currents, following the course of the wind, gradually turn more and more to the eastward, and increase in volume, in breadth and depth as they flow towards the equator until they unite and form the Equatorial Current.

For convenience, the northern portion of this great ocean river, which, as has already been shown, owes its origin mainly to the north-east trade wind, is called the North Equatorial Current, while the southern portion, which is derived mainly from the south-east trade wind drift current, is called the South Equatorial Current; but there is in fact no definite dividing line, except that during the six months of the year, June to November, the heaped-up waters of the two currents overflow between the 3rd and 13th parallels of north latitude, east of about the 50th meridian, and turn to the eastward, thus becoming a counter current, which subsequently joins a south-eastward setting branch of the north-east trade wind drift current, and a north-eastward setting branch of the south-east trade wind drift current, when the combined current flows eastward, immediately south of and parallel to the Guinea Coast (Fig. 3).

Pursuing its course to the south-eastward, and eastward, with an average annual velocity of about 17 nautical miles a day, the greater portion of the North Equatorial Current pours into the Caribbean sea, through the passages between the Windward islands, while the northern edge of the current runs to the north-westward immediately to the northward of the West India islands and between Cuba and the Bahamas until it joins and considerably augments the Gulf Stream flowing out of the Strait of Florida. As they proceed northward, the former has a higher temperature than the latter and a lower rate of motion. The South Equatorial Current, as it flows north-eastward and eastward with an average annual velocity of about 23 nautical miles a day, also divides into two branches. The northern, and by far the more extensive branch, skirts the north-east coast of Brazil, and unites with the main branch of the North Equatorial Current, the southern edge of which has been diverted by the Guayana coast. They then pass into the Caribbean sea. The combined current, running with a mean annual velocity of

about 23 nautical miles a day,* is there impelled towards the coasts of Honduras and Yucatan, and the main body of the stream flows directly through the Yucatan channel into the Gulf of Mexico. The southern branch of the South Equatorial Current, obstructed by the land at Cape St. Roque, flows to the south-west along the Brazilian coast. Issuing

MONTHLY CURRENT CHARTS—ATLANTIC OCEAN.
AUGUST.

FIG. 3.—THE EQUATORIAL COUNTER CURRENT, AND THE COURSE OF THE GULF STREAM NORTH-EASTWARD, ARE INDICATED BY FINE LINES, WHICH DEFINE THEIR NORTHERN AND SOUTHERN BOUNDARIES.

* In January and February the mean maximum velocity of the North Equatorial current is estimated to be 28 miles a day, the mean minimum being 5 miles; while the mean maximum velocity of the South Equatorial Current is 38 miles a day, and the mean minimum 7 miles. In the Caribbean sea the mean maximum velocity is 39 miles and the mean minimum 10 miles

In July, also in August, the corresponding values are: for the North Equatorial

from the Yucatan channel, part of the main stream runs into the Gulf of Campeachy, thence making the circuit of the Gulf of Mexico, and part turns north-eastward, both meeting between the Tortugas bank and the north coast of Cuba and flowing into the Gulf of Florida.

Between the Dry Tortugas and Havana, the locality in which the current is known first by the name of "Gulf Stream," the channel is 95 miles wide; between Kay Sal bank and Sombrero Kay it is 54 miles. The narrowest and shallowest part of the channel is off Cape Florida, where it is no more than 44 miles wide; and between Jupiter inlet and the north-west edge of the Little Bahama bank it is 47 miles in width. After escaping in the Atlantic from this narrow channel in Florida strait, which is 330 miles in length, the Gulf Stream, reinforced by the northern branch of the North Equatorial Current, speeds northward and north-eastward, following the contour of the coast, and hugging the bank of soundings on its western side, where the stream is strongest, as far as Cape Hatteras.

The axis of the stream follows, for the most part, the 100-fathom line, at a distance of from 10 to 20 miles to the eastward of it, while its eastern border, which in consequence of mingling with Atlantic water becomes less and less marked, extends to a greater distance from the axis.

Commander Pillsbury states that the average volume of water passing in an hour through the Strait of Florida has been calculated and found to be ninety billion tons,* yet in that locality the stream is shallowest. This estimate can, however, be only an approximation.

North of Cape Hatteras the stream curves away from the coast of America, and spreads fan-like to the north-eastward. Its northern edge passes from 60 to 80 miles southward of Nantucket shoals, and from 120 to 160 miles southward of Nova Scotia, while a branch of the cold Labrador Current, following the coast, flows to the south-westward inshore of it sharply defined by its greenish hue, the Gulf Stream being a deep blue colour. Part of this branch usually flows into the Gulf of St. Lawrence, through Cabot strait on its northern side. Another branch of the current skirts the edge of the Great Bank of Newfoundland on the eastern side, in some months also flowing over the Bank; and, coming into collision with the Gulf Stream, continues its course to the southward for the most part under the stream. Still another branch of the polar current, at least during some period of the year, curves round the Flemish cap.

Current 27 miles and 5 miles; for the South Equatorial 40 miles and 8 miles, and for the Caribbean sea 35 miles and 9 miles.

Both the North Equatorial and the South Equatorial currents are stronger on their western than on their eastern sides.

These estimates are based on values given on the Monthly Current Charts for the Atlantic ocean, which were prepared in the Meteorological Office, and published by the Hydrographic Department of the Admiralty.

* 'The Grandest and most Mighty Terrestrial Phenomenon: The Gulf Stream.' By John Elliot Pillsbury, U.S. Navy. The *National Geographical Magazine*, 1912. Published by the National Geographical Society, Washington, D.C.

The separation of the Arctic Current from the Gulf Stream is also marked by temperature, the former having a temperature lower than the latter by from 10° to 25° or more, the temperature gradient being so steep that the division has become known as the "cold wall": it has also a much lower salinity. Near the coast of the United States, surface layers of warm and cold water are found running side by side. The cold Labrador current, which is variable in strength, but is said to attain at times a velocity of from 20 to 30 miles a day, flows along the coast, partly on the surface inside of the Gulf stream, partly as an undercurrent below the stream, but occasionally coming to the surface. It has, says Pillsbury, been traced as far south as the Tortugas; while at Sombrero Kay the cold wall was strongly marked at depths varying from 70 to 100 fathoms; warm water flowing over the cold, and reaching to the shore.

According to the 'United States Pilot,' * the average velocity of the Gulf Stream at the axis from Florida strait to Cape Hatteras is about 70 miles per day; at its western edge it is about 45 miles, and near its eastern edge 30 miles. Its rate decreases to the north-eastward, and south of Nova Scotia it runs at about 55 miles per day at its axis; near the northern margin 36 miles, and near its southern margin 24 miles; the axis of the stream appearing to be nearer its western and northern margins than its eastern and southern, where it is subject to tidal influences.

We have it on Pillsbury's authority that atmospheric pressure is a source from which abnormal variations in the volume of the stream arise in the Gulf of Florida. A high barometric pressure in the Gulf of Mexico, he states, accompanied by a lower pressure in the Atlantic, causes a great outflow from the strait, and *vice versâ*. The influence of barometric pressure is first felt at the edges of the stream where the current normally is weakest.

One of the most important results of Commander Pillsbury's investigations in the *Blake*, all of which are of importance, was the discovery that the velocity of the stream changes daily and monthly, and that the times of occurrence of these changes can be predicted. He found that a change in the velocity of the stream takes place when the height of the tide on the coast changes. The Equatorial Current flowing along the South American coast has its maximum velocity about six hours before the moon crosses the upper meridian; it attains its maximum between Cuba and Yucatan at ten hours before; and off Fowey rocks, in the Strait of Florida, at nine hours before. He ascertained that these variations amount to more than 3 miles per hour, at certain times in the month in some parts of the stream, but at other times less than 1 mile per hour. Also that following the changes in the declination of the moon another change takes place. Two or three days after the moon has passed the equator, that portion of the stream which runs with the greatest velocity, and is always to the left of the

* 'United States Pilot, East Coast,' Part I., second edition, 1909. Published by order of the Lords Commissioners of the Admiralty.

middle, is then nearest the middle ; and two or three days after the moon has attained its highest declination it is located on the left-hand edge of the stream. Moreover, at one time during the month, a time which varies with the moon's declinations, the direction of both surface and under currents, which usually run nearly parallel to the axis of greatest velocity, inclines towards the axis, thus causing an intermingling of the warm surface water with the cold water below it.

At the south-eastern and southern edge of the Great Bank of Newfoundland, the Gulf Stream, as already stated, comes into direct conflict with the Labrador Current, which, flowing southward, has skirted on its eastern edge and in some months invaded the bank ; and this current helps to deflect the course of the stream to the eastward. Not only is the progress of the stream greatly retarded by this conflict, but a great deal of its heat, which since its emergence from the Strait of Florida it has been steadily losing, is parted with, also much of its salinity. Between the 30th and 40th meridian the stream divides ; one branch of it, which circulates eventually round the Sargasso sea, turns to the eastward, south-eastward, and on nearing the coast of Europe to the southward, ultimately joining the north-east trade wind drift current, as before mentioned. This branch washes the coasts of Europe, skirts the African coast on its eastern side, and bends to the westward, towards the Azores on its western side.

The other branch, gaining renewed energy from the prevailing south-westerly winds, flows north-eastward, enters the Bay of Biscay, the English Channel, and passing through the Strait of Dover, invades the southern portion of the North sea as far north as the Dogger bank. The greater volume of the stream, however, continues to flow northward, and, arriving off the north of Scotland, is bent to the east by the Earth's rotation. It then passes into the North sea and Norwegian sea, through the Faroe-Shetland channel, over a partial submarine barrier known as the Wyville-Thomson ridge, and floods the northern part of the North sea as far south as the Dogger bank with relatively warm saline water. It also flows between Faroe and Iceland over the northern extension of the aforesaid submarine ridge into the Norwegian sea. This relatively warm, high-salinity water fills the greater part of the Norwegian sea, and a portion of it penetrates to the Baltic, through a channel which fringes the southern coast of Norway, called the Norwegian channel, and onward through the Skager Rak, the Kattegat, and Belts. The other portion passes northward into the Arctic, mainly as an undercurrent, and its presence has been detected in the Greenland sea under the ice-covered Polar stream, and in one spot off the west coast of Spitsbergen it again comes to the surface. It invades the Barents sea as an undercurrent, and is said *

* General Report of the Permanent Council for the Study of the Sea, vol. 3. Contribution by Professor Otto Pettersson (Sweden) and Mr. Martin Knudsen (Denmark).

to raise the temperature of the bottom layer from 1° C. (34° Fahr.) in June, the cold season of the water, to 5° C. (41° Fahr.) or more in November, the summer of the water.

It is probable, moreover, that yet another branch of the stream penetrates to high latitudes as an undercurrent north of Cape Farewell, through Davis strait as far as Baffin bay, and perhaps Smith's sound, where it comes to the surface. This would account for the relatively high temperature of the surface water in a certain locality that is found, in some months of the year, in Baffin bay, and is said to extend to Smith sound. It is known as the "North Water."

"Investigations covering a period of ten years," says Prof. Otto Pettersson, the eminent Swedish oceanographer, "in a General Report of the Permanent Council for the Study of the Sea,* tend to show that there is a flood period of the Atlantic water during autumn, and an ebb during spring. During the autumn months an inflow of warm water takes place in the most easterly division of the North Atlantic water system, the Barents sea, Kattegat, and Belts, while cold currents from the north prevail in spring."

The volume of the mixed Gulf Stream and Atlantic water north-east of the Shetlands increases from June to September. The water-level of the Norwegian sea, North sea, and Baltic sea has a well-marked annual period, being highest in October, lowest in March. In consequence of the heat exchange between sea and atmosphere a considerable retardation of the seasons occurs in Northern Europe, and this retardation increases with latitude.

Prof. Pettersson mentions that in the island of Röst, one of the Lofoden group, the lowest mean annual temperature occurs on February 25. This connection between the temperature of the sea and that of the air over lands adjacent to it will be referred to later. But apart from the retardation of the seasons, Pettersson considers that the climatic conditions of northern Europe might show the same stability as those of tropical countries, were it not for the non-periodic perturbations which are due to a delay in the maximum flow of the Atlantic Current—a delay that may vary from November to as late as January.

Reference is made by Pettersson to Russian investigations; and to the detection of an unusual expansion of the Atlantic current in autumn. He quotes Dr. Breitfuss, who, in his 'Oceanographical Studies of the Barents Sea,' says, in reference to the rise in temperature and increase of salinity of that sea, "We are confronted by a more powerful agent than either the heating of the sea surface during summer in these latitudes, or the dilution of the surface water by continental fresh water in winter. In my opinion this agent is the Atlantic Current itself, whose dynamic intensity in these parts of the ocean attains its maximum in November."

* "Conseil Permanent International pour l'Exploration de la Mer." *Rapports et Proces-Verbaux*, vol. 3.

Reference has been made in the foregoing to the Atlantic Current, and doubtless some of the present, who are but slightly acquainted with the literature relating to ocean circulation, will be at a loss to know to what ocean current I have alluded. This must explain.

During the progress of the Gulf Stream northward from the most southerly position in which the cold bands of the Labrador Current meet, in places, and mingle with the warmer and more saline waters of the Stream, the latter is continually parting with some of its heat and salinity, also with much of its energy; and in that locality where the stream comes directly into contact with the main body of the Arctic Current, and largely from the force of the impact, both stream and current are diverted from their respective courses, the loss of energy, heat, and salinity of the former is in the opinion of the majority of oceanographers so enormous, and the admixture of Polar and Atlantic water so considerable, that very little, if any, of the Gulf Stream, as such, can be traced much farther north eastward. They believe that, in its stead, or reinforcing what little of the original stream remains, a relatively warm saline current is set up and maintained by the prevailing south-westerly winds. It is this stream or current, named by them the Atlantic Current or North Atlantic Drift Current, or the European Current, which they say washes the coasts of Europe, fills the seas and channels adjacent to our islands, and makes its way into the Barents and Greenland seas.

Others assign to the Gulf Stream a longer life, and contend that not until it has attained the 40th meridian of west longitude are its characteristics lost, but that thence the stream which flows north-eastward bears no relation to that head of water which was acquired in the Gulf of Mexico from the joint Equatorial Currents; but that the power necessary for the continuance of the stream comes from the prevailing south-westerly winds only.

From both of these theories I venture to differ; and to express the belief that the warm water of relatively high salinity, which undoubtedly exercises an ameliorating effect upon the climate of our islands and upon that of north-western Europe generally, is mainly of equatorial origin, and is directly attributable to the agency of the Gulf Stream.

In support of this belief, let me refer you, in the first place, to a chart of surface temperature of the North Atlantic in order to show what evidence the distribution of mean annual surface temperature will reveal (Fig. 4). This is from a chart which was compiled in the Meteorological Office, and is based on innumerable observations extending over a period of thirty-five years or more. The Equatorial Current, the Counter and the Guinea Currents, broadly stated, are found between the 80° isotherms or lines of equal temperature. In the Caribbean sea the temperature of the Stream is somewhat higher. In the southern and western portion of the Gulf of Mexico a sufficient number of observations is wanting, but the values charted over the remaining portion of the gulf suffice to prove

that the temperature of the Equatorial Current there is still high, except where lowered by the outflow from the Mississippi. From Florida strait north-eastward, the effect of the Current, known to all during the remainder of its course towards the Great Bank as the "Gulf Stream," is indicated by the deviation of the isotherms from the east and west direction, and their bend north-eastward about as far as the 40th parallel of north latitude on a line drawn between the strait and Cape Race.

The effect of the collision between the Gulf Stream and the cold Labrador Current is boldly marked by the steep temperature gradient from 40° to 46° N. Now trace the course of the isotherms onward. The isotherm

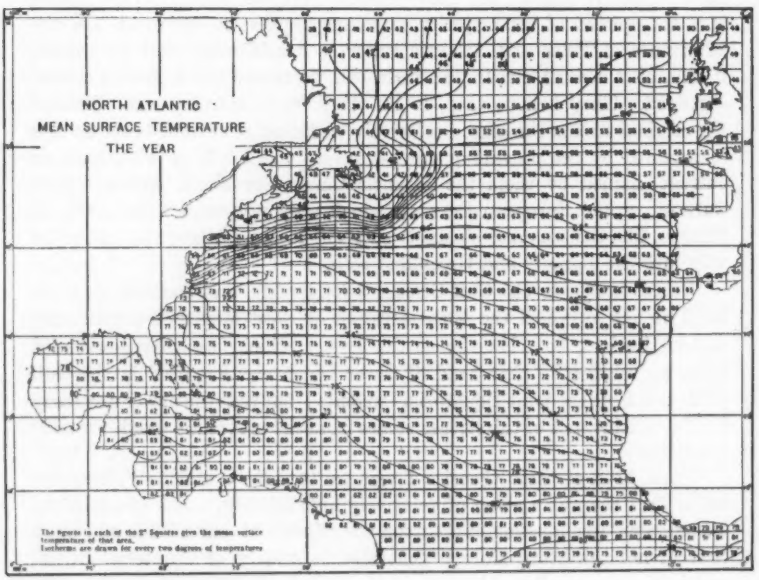

FIG. 4.

of 50°, which on the 50th meridian is in 43° N. lat., on the 28th meridian is in 60° N.; the isotherm of 52°, which on the 50th meridian is situated only a few miles south of the 50° isotherm, on the 10th meridian is in 57° N.; but the isotherm of 60°, which on the 50th meridian is in about 41½° N., reaches the coast of Portugal, after making a curve northward, in about the same latitude. In other words, the surface temperature of the Atlantic between the 43rd and 60th parallels and the 4th and 32nd meridians is the same as that which is found on the 50th meridian between the 41st and 43rd parallels, where the Gulf Stream and Labrador Current meet.

Now let us see what corroborative evidence a chart of average salinity will afford. This chart (Fig. 5), showing the average annual distribution of salinity in the Atlantic ocean, is, for the most part, a reproduction of one given by Prof. Schott in his valuable monograph on the geography of the Atlantic ocean.*

The distribution is indicated by isohalines, or lines of equal salinity. The values to which these isohalines relate represent salts per mille, *i.e.*

FIG. 5.—MEAN SALINITY OF THE SURFACE WATER. AFTER PROF. GERHARD SCHOTT.

the weight of salts in 1000 parts of water. The salinity of water is the total weight in grams of solid matter dissolved in 1000 grams of water. This solid matter is made up of a number of different salts, more than three-fourths of which consists of sodium chloride or common salt. Although the salinity of the sea varies somewhat in different localities,

* 'Geographie des Atlantischen Ozeans,' von Professor Dr. Gerhard Schott. Ableitungsvoistand bei Deutschen Seewarte, Hamburg. Vorlag von C. Boysen, 1912.

times, and seasons, because its degree of saltness depends upon the removal from or addition to it of fresh water by evaporation, precipitation, and drainage from the land, yet the ratio of the different salts is substantially constant.

On this chart the elliptical areas of relatively high salinity in the tropics of each hemisphere indicated by the 37°/₀₀ isohaline and above are related to elliptical areas of high barometrical pressure over regions of minimum rainfall and maximum evaporation. The wedge-shaped area of low salinity within the 35°/₀₀ isohaline, protruding westward from the African coast, is related to a belt of calms and light variable winds, called the "Doldrums," already referred to, where the rainfall is large and evaporation small.

The tropical areas of maximum salinity 37·5 extend to a depth of 400 metres (nearly 220 fathoms) in the North Atlantic, and to 100 metres (nearly 55 fathoms) in the South Atlantic, whereas the wedge-shaped area of low salinity 35 and less extends to a depth of only 25 to 50 metres (say 14 to 27 fathoms), a layer of fairly high salinity water lying below it.

Now, salinity indicates even better than temperature the places of origin of different water layers; therefore, just as we have traced the courses of the 50°, 52°, and 60° Fahr. isotherms northward and eastward from between 40° and 44° N. lat., where the Labrador Current and Gulf Stream meet, so will we now trace the courses of the 35, 35·5 and 36°/₀₀ isochalines from that locality.

From about 41° N., between 50° and 60° W., the 35 isohaline extends eastward and slightly northward to about 40° W., where it turns abruptly northward. It reaches Denmark strait, between Greenland and Iceland; takes an equally abrupt turn to the eastward, and in about 6° W. again bends northward into the Arctic ocean to Spitzbergen; eastward into the Barents sea, and south-westward, following the north and north-west coasts of Norway and the north coast of Scotland.

The 35·5 isohaline extending eastward and slightly northward to about the 40th meridian, there bends north-eastward until reaching about the same parallel as the Hebrides in about 7° to 8° W., it turns sharply southward, and when past the south of Ireland curves into and round the Bay of Biscay. The 36 isohaline, while extending eastward from 40° N., 50° W., curves more slowly northward to about the 15th meridian in, say, 45° N., when it turns southward and follows the coasts of Portugal and Morocco.

The northern portion of the North Atlantic, the southern portion of the Greenland sea and the part of the Barents sea which are enclosed by the 35 and 36 isohalines, are filled with water of the same salinity as that which we find in the Gulf Stream between Cape Hatteras and its place of meeting with the current from the north.

Now turn your attention to the South Atlantic, and see how much farther north we have to look for similar salinities. The isohaline of 36 is not to be found much farther south than 30° S. lat., and the 35

not farther than 42° S. lat.; and that only on the western side of the South Atlantic where the Brazil current carries southward the higher salinity waters of the tropics. On the eastern side of the ocean in 5° W., the 36 isohaline does not extend farther south than 25° S., and the 35 isohaline not southward of 35° S. on that meridian.

Water of relatively high temperature and salinity from the Mediterranean is said to reach and mingle with the waters near our shores. It is believed to be derived from the lower water layers of that sea, which

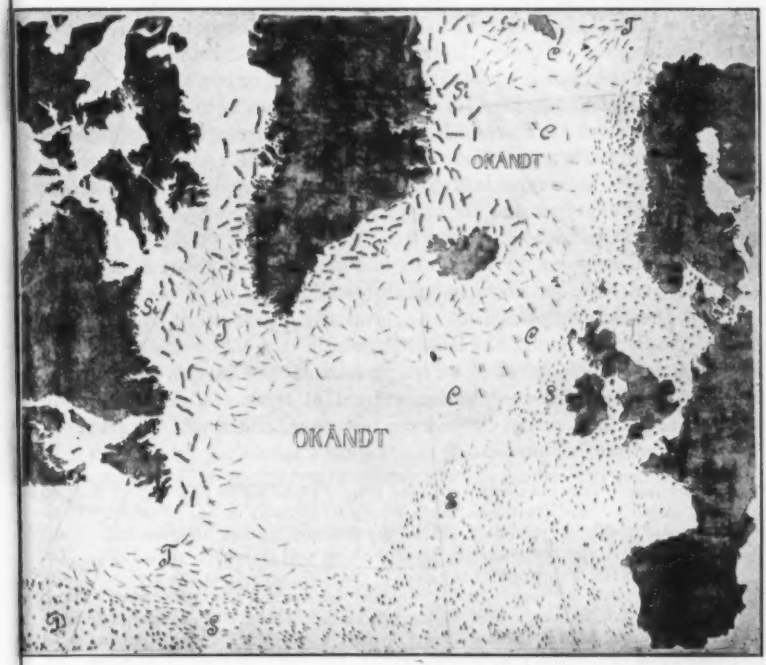

FIG. 6.—DISTRIBUTION OF PLANKTON TYPES IN THE NORTH ATLANTIC DURING SUMMER. (*By P. T. Cleve.*)

issue from the Strait of Gibraltar as an undercurrent and to be deflected northward by the Earth's rotation. What evidences there are to support this proposition I have not been able to ascertain, but to me it appears improbable that even a strong current which has to overcome the friction on all sides of alien waters could penetrate to a distance of say 1000 miles, after the loss of energy entailed by so sharp a turn northward.*

* After this paper was in type I was afforded an opportunity of glancing through a monograph by the eminent and far-famed explorer, Dr. Fridtjof Nansen, entitled 'The Waters of the North-Eastern North Atlantic,' which appears as a

Sometimes the marine biologist is invoked for the purpose of refuting, by the evidence of his investigations, the agency claimed for the Gulf Stream in the amelioration of our climate.

Fig. 6 is a reproduction of a Plankton map of the North Atlantic given by the Swedish chemist and botanist, P. T. Cleve, in his 'Treatise on the Phytoplankton of the North Atlantic and its Tributaries.'* The original map, which Cleve refers to as a "First essay in a schematic map of Plankton; the Atlantic summer-state," was shown at the Exhibition at Stockholm in 1897.

The term "Plankton," introduced by Victor Hensen in 1887, is used to describe generally those minute marine organisms which without volition are transferred from one part of the ocean to another by currents; phyto plankton is plant-plankton.

The types of plankton included in this map are principally those of the diatom forms; the diatom being a single-cell vegetable organism. Cleve classifies these types in six groups, to which he applies arbitrary terms. These plankton-types and the respective symbols by which they may be known are as follow:—

Ċ.—Chaetoplankton—"occurs in North Atlantic between styli and trichopl. and north to Spitzbergen."

/// D.—Desmoplankton. "The prevalent plankton of the Antilles Current and of the Brazil Current."

/\/\ S.—Styliplankton. "As it prevails in the eastern part of the Atlantic, it may be concluded that the water with the styli-plankton comes along Africa, and is connected with the plankton of the Indian ocean."

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supplementary number of the International Review ('The waters of the North-Eastern North Atlantic. Investigations made during the cruise of the *Frithjof*, of the Norwegian Royal Navy, in July, 1910.' By Fridtjof Nansen. Sonderabdruck aus International Revue der gesamten Hydrobiologie und Hydrographie, 1913). Dr. Nansen traces the deep water of the Rockall channel partly from the Mediterranean, by reference to the vertical distribution of temperature and salinity between Spanish bay and Rockall, based on observations in certain localities. He furnishes an illustration of a section of the Atlantic from Spanish bay to the Faroe-Shetland channel showing this distribution; and maintains that the warm current flowing north-eastward towards the British isles is not a continuation of the Gulf Stream, but is to a very great extent a current coming from the south along the continental slope west of Europe.

That is all I was able to gather from my glance through one or two chapters of the book. Nansen, as we all know, is a high authority upon the subject, so that I would not lightly question either his premises or conclusions; nevertheless, I still hold to the opinion, which is based on the results of current observations, supported by observations for surface temperature and salinity, as well as by my personal experience, that most of the warmth conveyed from lower latitudes, which reaches the seas and channels around our coasts, is derived from a warm current from south-westward, which is a branch of the Gulf Stream.

* 'A Treatise on the Phyto-plankton of the Atlantic and its Tributaries and on the Periodical Changes in the Plankton of the Skagerak.' By P. T. Cleve. Upsala, 1897. Printed by Upsala Nya Tidnings Aktirnbolags Nyckeri. Published by P. T. Cleve.

Si.—Siraplankton. "This type characterizes the plankton of the Arctic ocean."

T.—Trichoplankton. "The region where this type prevails is the south-west of Iceland."

Tp.—Tripos plankton. "In summer it prevails in the north-east between Scotland, Shetland, and Norway."

Neritic plankton-type have also been included under the symbol Tp. The term "Neritic" is applied to plankton-types which are confined to coastal waters, as distinguished from "Oceanic," the habitat of which is the open sea exclusively.

"Okändt" signifies unknown.

It will be seen that Desmoplankton, which is of equatorial origin, does not appear on this map in a higher latitude than 40° N., but, on the other hand, Siraplankton of Arctic origin is not indicated farther south than 45° N., although, admittedly, the waters of the Labrador Current penetrate to sub-tropical and even to tropical regions.

Plankton of tropical origin is not infrequently found in the neighbourhood of the British Islands. For instance, in July, 1906, a species of pelagic mollusc, which abounds in the south-western Atlantic, was found in the English Channel. In that month and during the remaining months of that year the surface water of the North Atlantic was considerably above the average temperature. In the previous year surface water of $37^{\circ}/_{\infty}$ salinity and above was traced from a locality between the 20th and 25th parallel and the 50th and 60th meridian to a position off the west coast of Ireland at the beginning of August, and to the entrance of the English Channel in the middle of the same month. Unfortunately, the collection of salinity data relating to the North Atlantic was discontinued after that year, and not resumed until recently.

Probably no animals belonging to the oceanic plankton can safely be said to be of equatorial origin. The animals which are found in what I must call the "hot-water" regions spread over the warm-water regions, and as a rule have a wide range. Physalia, a siphonophor, popularly known as the "Portuguese man-of-war," which frequents the tropics, and rarely occurs in our seas, was present on the south coast of England in March and April, 1912, and formed the subject of an interesting letter in *Nature* * from Dr. J. H. Orton, of the Marine Biological Association. Dr. E. J. Allen, the Director of the Association, tells me that Physalia occurred on the south coast also in February, March, and April of last year; and I have it from another reliable authority that off Plymouth last October there was a shoal of Liriope (Trachomedusæ), a distinctly warm-water medusa, occurring in the tropical regions of all oceans.

Other tropical or warm-water animals mentioned by my informant, as occasionally found near our shores, especially off the west coast of Ireland, but seldom off Devon and Cornwall, are: Ianthina (gastropod), a sea-snail,

* *Nature*, vol. 90, 1912–13, p. 700.

with a beautiful mauve-coloured shell; Velella (syphonophor), allied to Physalia and somewhat like; Pelagia (scyphomedusa), a jelly-fish.

The medusoid fauna of the Gulf Stream off the Tortugas is distinctive, but none of the species have been taken near our shores. They have a short life, and the time-limit is an important factor, unless reproduction takes place on the journey.

Whether the relatively warm saline stream or any part of its waters which flows north-eastward from the region south of the Great Bank is derived from that stream which issued for the most part from the Gulf of Mexico, or, as some aver, is an independent stream which takes its origin in the former locality, is a question which must remain unsettled until the results of further investigations are available. This, at the least, we know, that from the Strait of Florida northward and north-north-eastward to the edge of the Bank; thence north-eastward, as well as eastward, across the ocean, aided, no doubt, by the prevailing westerly and south-westerly winds, there exists throughout the year a continuous flow of warm saline or relatively warm saline water, to the north-easterly branch of which these islands owe much of their salubrity.

The salubrity of our climate is, of course, largely due to its comparatively mild and even temperature. The relatively small annual range of temperature that obtains normally results from our insular position; the warmth we owe also in a large measure to the surrounding sea which receives much of its heat from that ocean stream, the course of which we have been following.

The temperature of the Northern Atlantic may be lowered in several ways, one of the most potent of which is the encroachment of the Labrador Current. Consequent upon any increase in the activity of this current from Arctic regions, a larger than usual volume of cold water is poured into the north-western arm of the ocean; and the lowering of the temperature is not confined to that part of the North Atlantic, but it is communicated to water layers to the eastward and southward. The lowering of the temperature of the sea surrounding our islands by the Labrador Current may be effected in another way; a stronger current will deflect the course of the Gulf Stream in parallels south of those in which it is normally diverted. The sea is thus deprived of much of the warming influence of the north-easterly branch of the Stream, in addition to being chilled by the cold current from the north.

Occasionally it may happen that an increase in the activity of the Labrador Current is synchronous with a decline in the velocity and volume of the Gulf Stream; then, over a large area of the North Atlantic the surface temperature will fall below the average for the period.*

* 'The Effect of the Labrador Current upon the Surface Temperature of the North Atlantic; and of the latter upon Air Temperature and Pressure over the British Isles.' Part I. By M. W. Campbell Hepworth. Geophysical Memoirs, No. I. Published by the authority of the Meteorological Committee.

Not infrequently, moreover, a decided fall in the temperature of the sea in the neighbourhood of our islands is occasioned by an invasion of the Greenland, or as it is more often called, "the East Icelandic Polar Current."

This was so obviously the case in the spring, summer, and autumn of 1912, that a curve exhibiting departures from the normal in sea surface temperature in a zone situated between South Greenland and the Orkneys has been added to the curves relating to that year, which, with other diagrams illustrating fluctuations in sea and air temperature, I propose to show you.

The observations of sea surface temperature in the zone referred to were kindly contributed by Captain Carl Ryder, the Director of the Danish Meteorological Institute at Copenhagen.

Air temperature over these islands is modified by changes in the surface temperature of the ocean in at least three ways—by winds that come from seaward; by the influence of sea temperature upon the course taken by low-pressure wind systems, usually referred to as *depressions*, which pass over or near them; and by a diminution of cloudiness.

The temperature of the air is soon modified by the temperature of the surface water over which it passes. When the surface temperature of the north-eastern arm of the North Atlantic is much below the normal, atmospheric pressure over the Iceland-Faroe region has a tendency to increase, and the centres of depressions visiting North-Western Europe to be diverted to a more easterly direction and to pass directly over the British Isles or not far north, and at times even south of their coasts, bringing to our islands much cloudiness and rain. On the other hand, during seasons in which the warm stream extends as far to the north-eastward as its average limits or still farther north, depressions travelling eastward and north-eastward from the Atlantic pursue paths which take their centres to the north-westward of our western and northern shores, with the result that a mild or comparatively mild type of weather conditions accompanied by more or less sunshine prevails.

The association of bright warm weather in summer with sea temperature above the normal may perhaps be accounted for by the small difference obtaining between the temperature of the air and that of the surrounding sea, the consequent diminution of cloudiness, and corresponding increase of sunshine. In that season, moreover, a diminution even in the quantity of vapour in the atmosphere during the day and following night is attended by a rise in the mean temperature of the twenty-four hours, because the heat the Earth receives by solar radiation exceeds that which it parts with by terrestrial radiation.*

I will endeavour, in the short time at my disposal, to show you by means of diagrams the somewhat frequent correlation of sea temperature with

* *Ibid.*

the air temperature over our islands during the decade 1903–1912. The diagrams and the remarks upon them are derived from two Memoirs by the writer, published by the authority of the Meteorological Committee, entitled 'The Effect of the Labrador Current upon the Surface Temperature of the North Atlantic and of the latter upon Air Temperature and Pressure over the British Isles.'

In order to confine within manageable limits that portion of the inquiry which relates to sea surface temperature, the North Atlantic is represented by a broad zone situated between Florida Strait and Valencia in the south-west of Ireland. It happens that the changes in surface temperature

MEAN SEA SURFACE ISOTHERMS OF THE NORTH ATLANTIC.

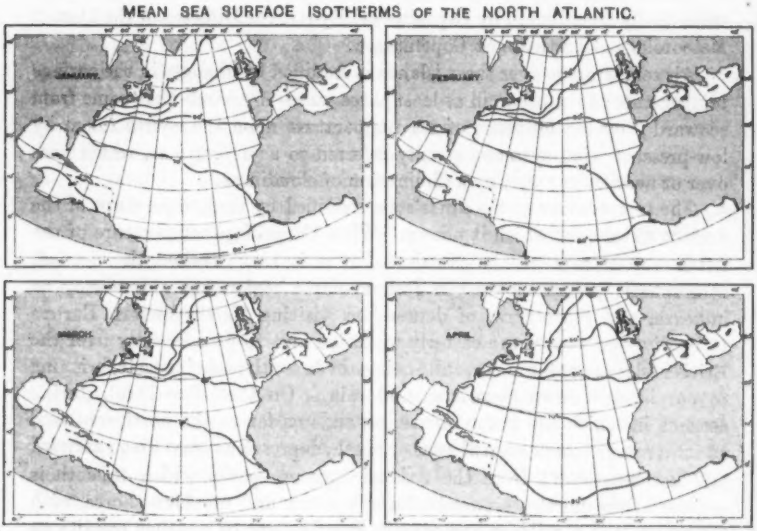

FIG. 7.

which may be regarded as of premier importance in this connection occur in this zone.

In the diagrams relating to sea temperature in this Florida-Valencia zone, the excess or defect in the surface temperature is expressed by the number of degrees of longitude in which the 70°, 60°, and 55° isotherms are east or west of their average limit for the month. The average limits of these isotherms in each month are indicated on Figs. 7, 8, 9, which illustrate at the same time the normal march of the seasons as regards sea temperature throughout the year. From these it will be seen that when an isotherm is west of its average limit, it is also south of that limit; and when it is east of that limit, it is also north of it; because the temperature gradient lies, for the most part, in a north-east and south-west direction.

Air temperature over our islands is represented, roughly it must be

MEAN SEA SURFACE ISOTHERMS OF THE NORTH ATLANTIC.

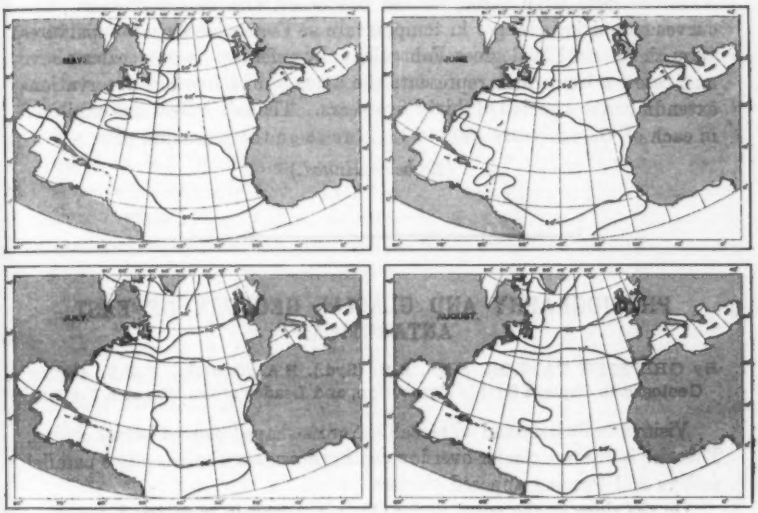

FIG. 8.

MEAN SEA SURFACE ISOTHERMS OF THE NORTH ATLANTIC.

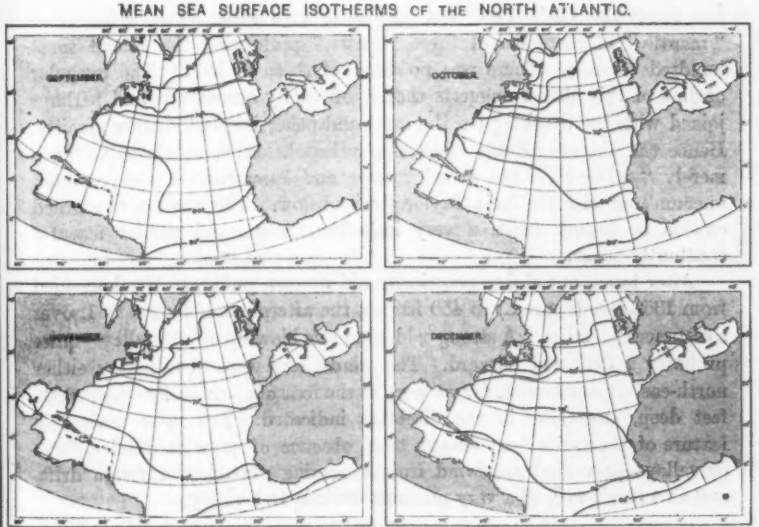

FIG. 9.

admitted, by the temperature registered at three stations widely separated: Valencia, Sumburgh Head, in the Shetlands, and North Shields. The curves exhibiting changes in temperature at these places show departures from the normal in degrees Fahrenheit, by reference to the scales above and below a line which represents the average of numerous observations extending over a period of thirty-five years. The salient features exhibited in each of the ten years 1903 to 1912 are as on the preceding page.

(*To be continued.*)

PHYSIOGRAPHY AND GLACIAL GEOLOGY OF EAST ANTARCTICA.*

By GRIFFITH TAYLOR, B.Sc., B.E. (Syd.), B.A. (Cantab.), F.G.S., Senior Geologist to Captain Scott's Expedition, and Leader of the Western Parties.

Visitors to Switzerland will recall the cross-shaped plan of Lake Lucerne. This also is due to a glacier-overflow cutting down a col between two parallel valleys and forming apposed glaciers.

On the slope to the north under Obelisk mountain were two interesting glaciers. We named them from their shape, "Cat's Paw" and "Stocking" glaciers. They spread over a low range of hills, shaped somewhat like a broad terrace. There seemed to be some slight retrocession since 1903; for then the Cat's Paw was furnished with relics of a well-defined "mantle" in the form of three "claws," prolonging the glacier some hundreds of feet. There was no trace of these in 1911. The irregular outline of this glacier suggests that it originally spread out and perhaps joined with the Stocking (to the east) and other isolated curtain glaciers. Hence the absence of any trace of a valley below these glaciers. They merely "spill over" the broad terrace and hang there supinely—quite unconnected with the main Taylor glacier below. This absence of marked erosion is, to my mind, a very important point, and similar features constantly occur.

After lunch our sledge practically did its own pulling. We descended from 1350 feet (approx.) to 450 feet on the afternoon of February 1, over a distance of 8 miles. A strong cold wind was blowing up the valley—quite probably a deflected blizzard. The winds here were of necessity either north-east or south-west, for we were at the foot of an unbroken gorge 6000 feet deep, stretching in the direction indicated. The most noticeable feature of the region—an almost total absence of snow on glacier, slope or valley—prevented any wind from becoming obnoxious through drift, and as a result we had a very pleasant week in Dry valley.

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* Royal Geographical Society, January 15, 1914. Continued from p. 382.

As we moved down along the moraine we came on specimens of Beacon sandstone. All hands examined carefully these—the first sedimentary rocks we had seen—in the hope of finding fossils, but unsuccessfully. The moraine consisted of large blocks up to 12 feet in diameter, scattered at intervals of many feet. As in the Ferrar glacier, the surface streams ran diagonally towards the north-east. We could soon clearly observe the great "groin" (mentioned by Captain Scott) blocking the valley, and at about 6 o'clock the slope became too steep for the sledge. We halted therefore about a mile from the snout and prospected for a good camp site. There was no snow anywhere, and the edge of the glacier was a steep slope some 40 feet high, down which it would be little advantage to lower the sledge. The centre of the glacier was cut up by surface streams into asymmetric ice gullies 20 or 30 feet deep. Along the sunny (southern) side of these gullies was a series of "alcoves" arranged like the stalls of a choir. They were 30 feet deep and about 100 feet across and were most beautiful objects; their steep faces being fretted by the sun into a thousand pilasters and niches.

On the northern side these alcoves were much smaller, but presented the same features. We lowered the sledge down a convenient "chimney" in the wall by means of the Alpine rope, and proceeded to pitch our tent on the rough ice forming the level floor of the alcove. Here were ideal conditions for a sheltered camp, with the exception of the floor, which was wet. We had a strongly running stream 1 inch deep alongside, and

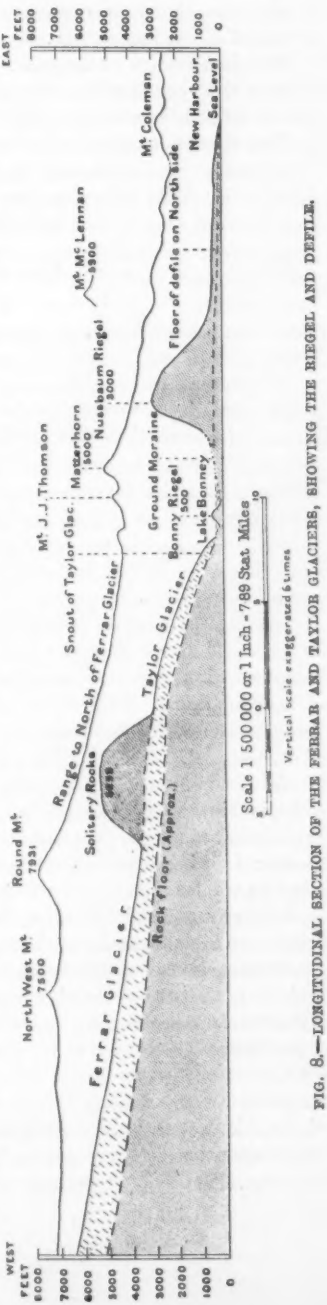


FIG. 8.—LONGITUDINAL SECTION OF THE FERRAR AND TAYLOR GLACIERS, SHOWING THE RIEGEL AND DEFILE.

though the wind howled along the surface of the glacier, we were undisturbed in our nook below.

The lower slopes of the hills contracted below the snout of the glacier and practically enclosed it—save for a deep narrow gorge just under the 500-feet groin mentioned above. An oval lake some 3 miles long drained the glacier, the projected riegel giving it an hour-glass shape. Between Lake Bonney and the actual face of the glacier was an area of distributed silts, while nearer the front piles of silt and boulders protruded from below the ice. These had all the features of true eskers appearing as piers beyond the face of the glacier. The glacier also contained silt-bands, as much as 10 feet thick between layers of pure ice. These silt-bands across the face of the glacier were boldly curved—forming a wide arch or section of a dome, the centre being 30 feet above the limbs.

There seems little doubt that here we have a fine example of a glacial snout overriding its own sub-glacial and terminal *débris*. This demonstrates, of course, that here the ice is doing no cutting of its bed, even though it is still a huge glacier (35 miles long); but we cannot therefore deduce that at its maximum when it was 2000 feet thicker, it did not powerfully plane its bed. A parallel is that of a mountain stream entering a desert. Its erosive power is greater where the grade is greater. It is negligible at its mouth, but may have been immeasurably greater under less arid conditions.

Leaving the western arm of the lake, I proceeded east to the riegel. As I climbed up the slope of this hill, I was delighted to find the mass was composed of granite *in situ*. I had feared that it was merely a huge pile of *morainic débris*. This bar across a great glacial gorge is paralleled by many in the Swiss Alps, notably by the Mesocco and Faido examples, south of St. Gothard. The top of the riegel was rounded and fairly free from *débris*. The eastern (down-valley) side was precipitous with jagged contours, and in strong contrast to the gentler slope on the upper side. The old explanation would say that this difference marked the bygone action of the glacier; that it had planed off the upper sides and torn or plucked the rock away on the lee side. I formulate (*infra*) a theory of frost-cutting which is competent to explain this small riegel, and which accounts for the unusual abundance of fine gravel covering the slopes.

As we could not take the sledge beyond the glacier, on February 4 we packed up the tent and sleeping-bags with five days' food, and carried them east towards the sea. We walked along the northern edge of the lake over a belt of smooth ice about 20 yards wide. The water here was very deep, especially where steep cliffs fringed the lake. Towards the centre the ice soon became much broken, and then a large portion of the centre of the lake was occupied by silt and morainic *débris*. In fact, the deep water was probably controlled by the radiation from the dark rocks along the shore. The valley hereabouts was by no means steep-sided as a whole,

for there was a well-defined shoulder-terrace about 2000 feet above the lake-bed. Above this the cliffs were steep and facetted.

About 2 miles below the Taylor glacier a large tributary glacier almost reached the level of the lake. It was fed by three separate snow-fields, the ice being precipitated over a steep craggy cliff, and then reuniting into a broad glacier below. This I called the Sollas glacier. I was much surprised to find that after we had passed the lake the bed of the valley commenced to rise. This lake evidently occupies an area of internal drainage, and we pressed eastward wondering if we should be stopped by a range of hills. We crossed four large areas of level silt at varying levels, which Evans named the "Football Fields." They were actually "fossil lakes."

About 3 miles beyond Lake Bonney we reached the water-parting. The drainage from these high moraines was partly into Lake Bonney and partly to the east. Beyond this we could see the valley contracting to a

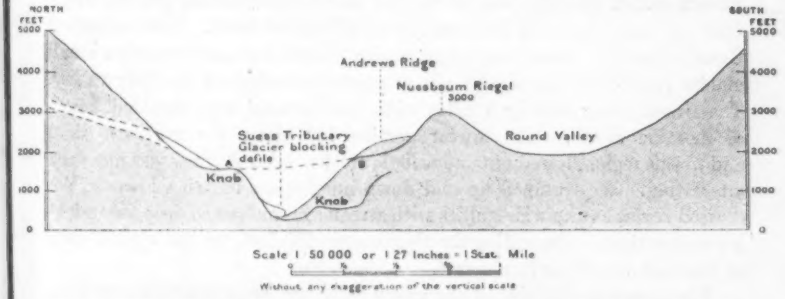


FIG. 9.—CROSS-SECTION OF THE TAYLOR TROG-TAL AT THE NUSSBAUM RIEGEL, SHOWING THE 1600-FEET DEFILE ON THE NORTH SIDE AND THE ROUND VALLEY ON THE SOUTH SIDE (LOOKING EAST TO THE SEA AND DOWN VALLEY).

defile; while striking knobs, recalling the Bonney riegel, bounded the narrow gorge and led to terraces about 1700 feet high.

Another small lake came into view receiving the drainage of the nearer side of the tributary Suess glacier, which we were approaching. It opposed a face of ice 40 feet high; but just where it butted into the steep (south) slope of the defile, there was a narrow gap between the ice and the cliff. Here thaw-ice had filled the interspaces between the blocks of cliff *débris* falling from the south. We could not see the sea from the top of the defile, and so moved east down the other slope and reached a lake nearly a mile long with a splendid gravelly shore, on which I decided to pitch our tent.

I was distinctly worried at the topography of the day's march. We had left a huge open valley—a suitable outlet for the Taylor glacier—and arrived at a narrow defile completely blocked by a comparatively small tributary glacier—the Suess glacier. We knew we must be near the sea,

but where was the open moraine-strewn valley described in Shackleton's book? So after supper Evans and I made straight for the top of Andrews' ridge, immediately south of the tent. It was a stiff ascent of 1600 feet, over rough blocks of slate in the upper portion.

We found a flat bare ridge at the top, with vertical strata obviously planed by bygone glaciers. But to my surprise I saw that a much larger valley lay immediately to the north of this ridge. As a matter of fact, here Dry valley consists of a large and wide, but rather elevated *high-level moiety* (which does not connect with the main glacier), and a *narrow defile* to the south, parallel to the other, but much deeper than it, by which the drainage of the western portion once reached the sea. These two valleys are separated by Andrews' ridge.

Next day Evans and I took the theodolite towards the sea to link our survey with Ross island. Our route lay down the defile, which we found to be practically filled by two elongated lakelets totalling 2½ miles. The eastern end of the defile was blocked by another debouching glacier, larger than the Suess, but with its snout practically at sea-level. This we named Canada glacier. From here we proceeded almost due east towards a small glacier (the Wales glacier) on the south-eastern slope of the Dry valley. The Broad valley, nearly 3 miles wide, was covered with tumbled heaps of moraine *débris*. The lowest portion lay along the northern side, and to this region flowed numerous little creeks. Our journey was not very interesting. We tramped up and down numberless moraine heaps. We crossed several quite wide gullies with streams an inch or so deep meandering across them. Ascending the slopes some 400 feet, we got a good view of Beaufort island far to the east.

The slopes on this side of the valley exhibited beautiful plane surfaces of the same nature and origin as those of the Ferrar glacier. The valley rose gradually to the west as a rounded moraine-filled curve. From this point of view (near to the sea) the true "pass" to the western regions—the defile—was practically invisible.

Summarizing the physiography of the Taylor glacier and Dry valley. The glacier reaches just within 20 miles of the sea, but the empty valley is crossed by two bars (or riegel)—the Bonney riegel, 500 feet high; and the Nussbaum riegel, 3000 feet high and 5 miles nearer the sea. Both the bars are cut by defiles, nearly to sea-level, at their northern ends. The asymmetric cross-section of the Nussbaum riegel, descending steeply on the inner side and very gradually to the sea, is especially noteworthy. The reason for this structure is discussed in a later paragraph.

The Koettlitz Outlet Glacier.—On February 17 we commenced our journey up the Koettlitz glacier. We had left one sledge on a low headland of moraine. This was studded with numerous crater-like lakes, and Debenham found that much of the promontory was built of primeval ice. It is possible that the circular form of these lakes, some 50 yards wide, is due to their origin as thaw-pools in the ice-borne moraine.

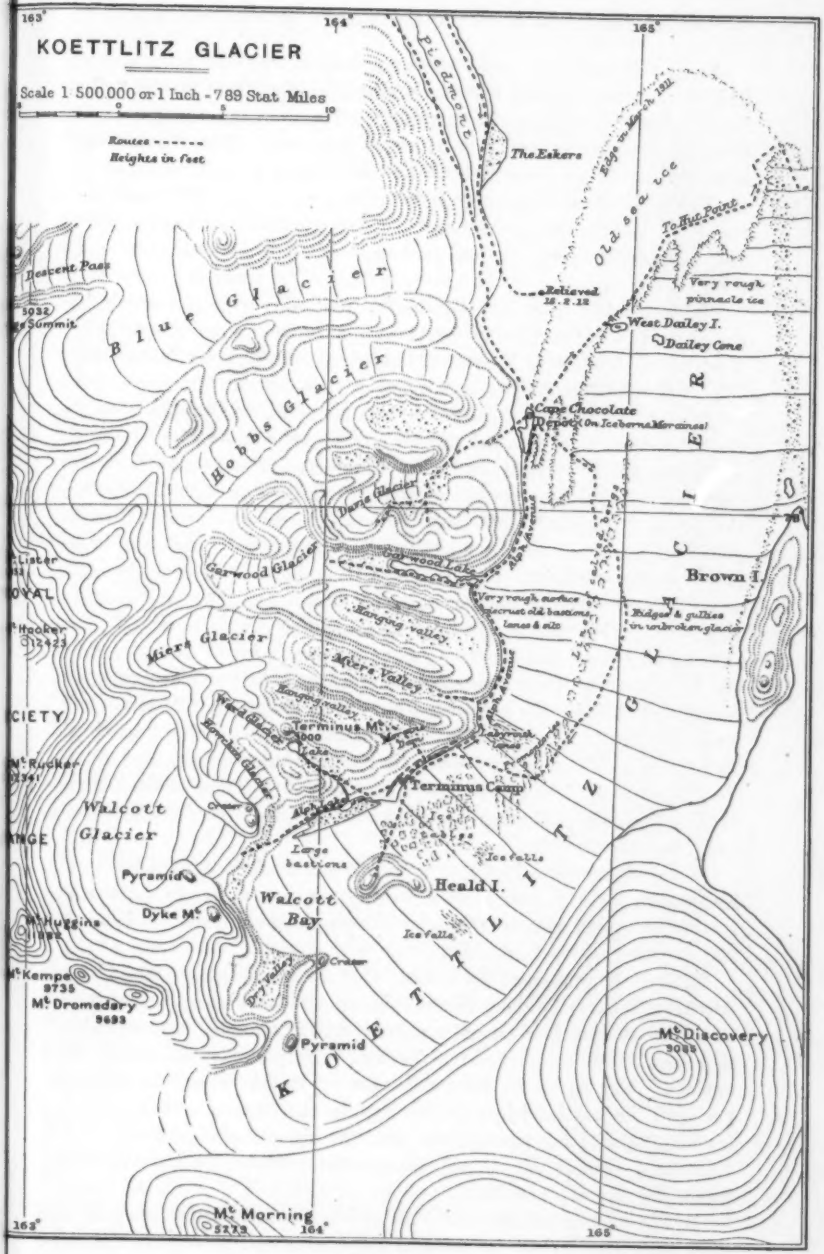

KOETTLITZ GLACIER
Scale 1 500 000 or 1 Inch = 7·89 Stat. Miles
Routes ------
Heights in feet
163°
164°
165°
Piedmont
The Eskers
Edge of Main Ice
Old sea ice
To Big Point
Relieved 15.2.12
Very rough pinnacle ice
West Dailey I.
Dailey Cone
Cape Chocolate
Depot (On Iceberg Moraines)
Blue Glacier
Hobbs Glacier
Ascent Pass
5032
Summit
Dare Glacier
Gerwood Glacier
Gerwood Lake
Brown I.
Very rough surface recruit old bastions lanes & silt
Ridges & gullies on unbroken glacier
Hooker
12423
Miers Glacier
Miers Valley
Hanging valley
Terminus Mt.
3000
Terminus Lake
Terminus Camp
Walcott Glacier
Walcott Bay
Large bastions
Heald I.
Ice falls
Pyramid
Dyke Mt.
Mt. Huggins
1995
Mt. Kempe
9735
Mt. Dromedary
9693
Dry Valley
Crater
Mt. Discovery
9085
Mt. Morning
8273
KOETTLITZ GLACIER

FIG. 10.

From this point we proceeded somewhat to the east over blue ice. This soon became rippled and degenerated rapidly into a fearful "glass-house" and "bottle-glass" surface. We began to fall through the ice into hidden channels, and in some cases there was a foot of fresh water awaiting us. It got worse and worse; we wriggled around ice mesas with vertical walls; over huge curved platforms which threw us all together in the centre, and then dropped beneath us. In fact, the surface was impossible, and I decided to return to the ice-borne moraines and leave one sledge there.

We spent two days investigating the tributary valleys and glaciers, entering the Koettlitz from the east and then made another attempt on the Koettlitz on the 20th. There were two types of "old ice" hereabouts. The first were "mesas" about 6 feet high, of which the pedestal was much undercut. This often gave rise to mushroom-shaped structures. Secondly, there were isolated ramparts of ice with a sloping side to the south, but nearly vertical on the northern face. These were fretted by sun weathering into surfaces resembling basketwork. We gave them the name "fascines." All these structures were due to the Koettlitz glacier being nearly stagnant. The silt blown across from the lateral moraines had sunk into the ice, and in the course of years the whole western surface of the glacier has been dissected in the most complete manner. During this week we struggled up the middle of this "frozen storm-tossed sea," and found a gradual evolution in the development of the ice pinnacles, which was some compensation for our slow and heart-breaking progress. We could trace the change from small "bottle-glass" projection to "fascines." These latter grew larger, forming "bastions" 30 feet high. These again became irregular tabular bergs; and we saw that the "bergs" had a tendency to unite and form promontories projecting from the unbroken glacier surface which occupied the eastern moiety of the Koettlitz.

The drainage was chiefly to the north-west. As our path lay to the south-west, we were continually crossing sunk lanes in the surface and getting entangled in a labyrinth of gutters and avenues which led every way but that which we desired.

Ultimately we reached the western edge of the glacier near Heald island. After crossing a steep sharp ridge of silt among high pinnacle ice, we found ourselves at last in a smooth avenue winding among the reticulated moraines. Here we pitched our Terminus camp and spent several days exploring the region to the north-west of Heald island (see Fig. 11). On each side of this island, which was in the form of a rounded ridge (nunakol) projecting through the ice, the big glacier descended steeply by icefalls. But all our journey hitherto had been over the lower Koettlitz, which was almost at sea-level.

Reverting now to the side walls of the lower Koettlitz, they do not show the characteristic facetting of the Ferrar and other outlet glaciers.

This portion of the glacier appears to be filling a large bay between Brown island and Mount Lister, rather than occupying a valley of its own erosion.

On the north-west the hinterland, between the Royal Society range (13,000) and the glacier, is some 10 to 20 miles wide. Its general elevation is 3000 to 5000 feet, but this is cut out into a most interesting series of radiating valleys. Their structure is most easily understood if one imagines that the scarp and hinterland are made of putty, and that the fingers and knuckles of one's hand be pressed into it. The knuckles will make rounded hollows like the cwms of Mount Lister—the fingers will press out radiating gutters like the valleys of the hinterland. As in the putty cast, so each valley is terminated at its landward end by a cwm or series of cwms. For this reason I have termed these valleys "Finger valleys" (see Fig. 10). There were half a dozen of these entering "at grade," and three or four hanging 1000 feet above the Koettlitz glacier. Time did not permit of our explorations extending south of Heald island. We ascended the latter on several occasions, and also climbed Terminus mount, a peak of 3000 feet, to survey the hinterland more exactly.

On March 2, we commenced our return march, following close to the coast; we found a frozen river which afforded us an easy route almost all the way to our depôt on the ice-borne moraines. We gave the name of Alph avenue to this highway. Below the ice we could see water draining to the sea, and I have little doubt that a sub-glacial stream flowed 20 miles in this fashion. Numerous seals used it as an easy route from the sea, for we found them far south in the moraines, just under Heald island.

The Mackay Outlet Glacier.—At this point the great plateau seems to come

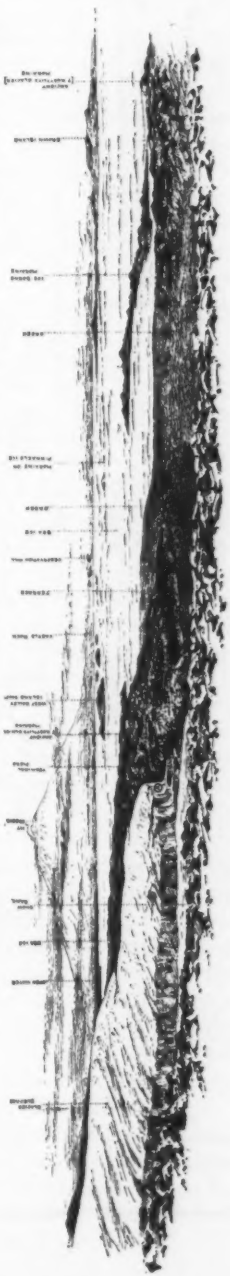


FIG. 11.—THE SILT DELTAS AT THE MOUTH OF HOBBS AND DAVIS GLACIER VALLEYS.

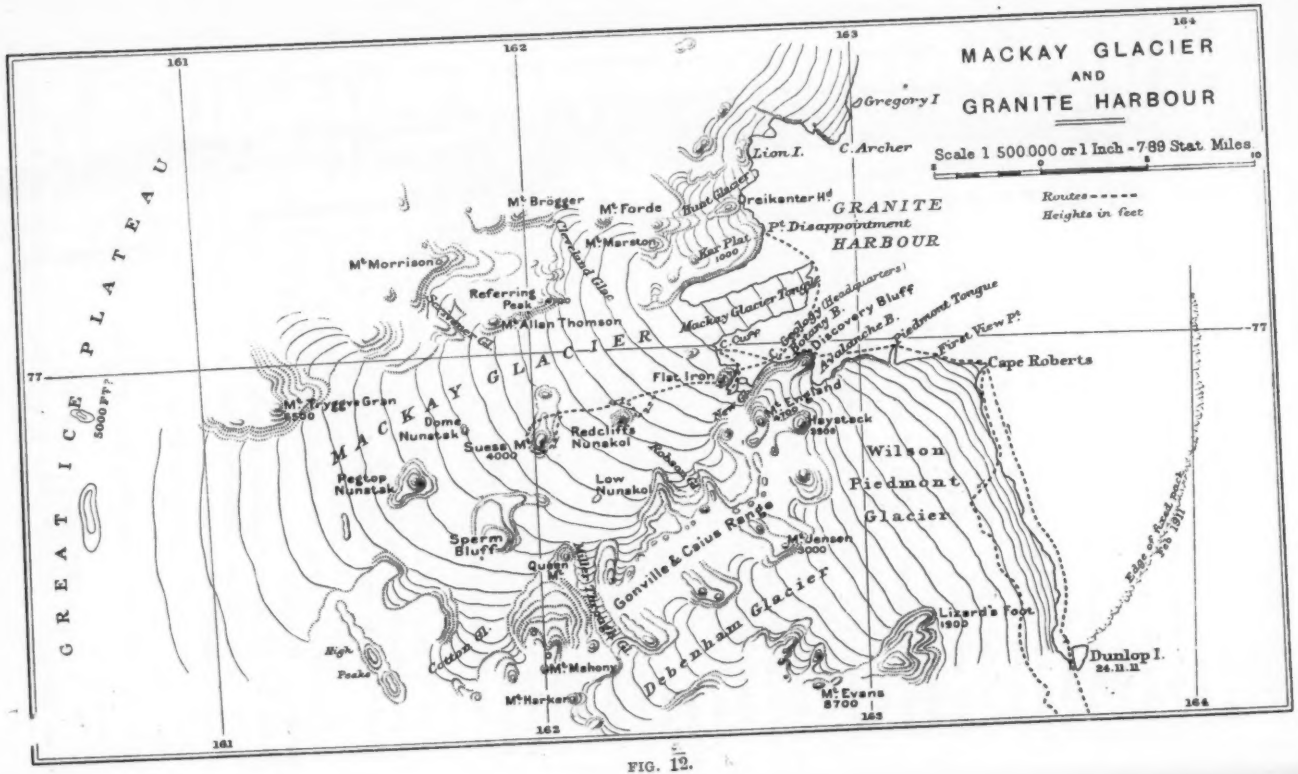

MACKAY GLACIER
AND
GRANITE HARBOUR
Scale 1 500 000 or 1 Inch - 7·89 Stat. Miles
Routes - - - - -
Heights in feet
GREAT ICE PLATEAU
5000 Ft.?
MACKAY GLACIER
GRANITE HARBOUR
Gregory I.
Lion I.
C. Archer
Mt. Brögger
Mt. Fordé
Mt. Marston
Mt. Morrison
Referring Peak
Mt. Allan Thomson
Dreikanter Hd.
Pt. Disappointment
Kar Flat 1000
Mackay Glacier Tongue
Headquarters
C. Crozier
Discovery Bluff
Piedmont Tongue
First View Pt.
Cape Roberts
Flat Iron
Mt. Tryggve Gran 3560
Dome Nunatak
Suess Mt. 4000
Redcliffs Nunatak
Haystack 3900
Wilson Piedmont Glacier
Red Top Nunatak
Low Nunatak
Sperm Bluff
Queen Mt.
Gonville & Caius Range
Mt. Jensen 3000
Debenham Glacier
Lizard's Foot 1900
Dunlop I. 24.11.11
Edge of fixed pack Feb. 1911
High Peaks
Mt. Mahony
Mt. Harker
Mt. Evans 8700
161
162
163
164
77

FIG. 12.

nearer to the coast than elsewhere in the region. It is reached at a lower level and forms a suitable route to the interior only 30 miles long; provided that the coastal cliffs of granite, 1000 feet high, can first be negotiated. This glacier is much more complex than the three we have considered. It is studded with nunatakker and nunakoller, especially in the southern portion. Mount Suess, 4000 feet high, is the most prominent; further west are pegtop nunatak and the dome nunatak. Sperm bluff and Redcliffs are flat-topped islands in the glacier which have been overridden by the Mackay glacier at its maximum; these I have named Nunakoller. The main flow of the ice is along the northern half of the glacier. This is shown not only by its continuity, but also by the extraordinary glacier tongue which prolongs the glacier to the east for over 5 miles.

Indeed, the southern moiety of the glacier entangled among the nunatakker is more of the nature of an ice-field. Large areas of it are not crevassed, and the only seaward outlet is in the south-east corner by the small New glacier. I believe that here we have an example of an ice-filled alb or upland terrace.

On each side of this broad glacier, some 10 miles wide, are magnificent snow-filled cwms interspersed with large tributary glaciers entering at grade. In the south a deep fiord-like valley is filled with a low-level glacier, the Miller Through glacier, which has all the appearance of being a transection glacier, connecting the Debenham and Mackay outlet glaciers. The beautiful facets on the north wall are among the most striking features of the Mackay glacier. There is a continuous series of these from Mount Tryggve Gran (6500 feet) to the east end of the Kar plateau (which we called Point Disappointment); a distance of nearly 25 miles.

The first feature that strikes the geologist as he proceeds north from New harbour (77½° S.) is that there is less and less land exposed below the snow and ice mantle. This implies, I think, that the precipitation in the south-west corner of McMurdo sound is extremely little, but increases both northward and southward. Thus all round Granite harbour, into which the Mackay glacier enters, there are only two small beaches uncovered by glaciers, and therefore reasonably accessible; whereas New harbour, but 40 miles south, is surrounded by beaches.

Hardly less noticeable than the facets are the elevated terraces which mark the ice-flood epoch. These are especially well shown in the *Kar plateau*, which has an average height of 1000 feet, and in the rocky promontory of the same height named the Flat Iron. The character of this floor is of great interest in that here is preserved the lately exposed bed of a glacier quite untouched by water erosion. Here are no fluvio-glacial deposits such as mark the floors of most temperate glaciers.

The northern portion of the main glacier was extremely crevassed, especially where the large Cleveland glacier entered it. Here it descended rather steeply, and the combined action of the lateral thrust and of the grade resulted in a field of broken ice such as I have never seen elsewhere.

It extended over several square miles, and was so striking a feature of the topography that we named it the "*Skauk*" (a Norwegian word used for such structures by Gran). And yet this tumbled sea of seracs and crevasses passed on to form the floating Mackay tongue, and became so firmly cemented that at the eastern end of the latter hardly a crevasse appeared. This tongue was 5 miles long and about 1½ miles wide, with parallel side and ending in three splay fingers. There was no break between the sea-ice and the tongue, showing that the latter was floating with the sea-ice. But the sea-ice at the Bluff 2 miles off is buckled into numerous corrugations by the pressure of the tongue. These are in the form of oval ridges about 100 yards long and as much as 10 feet high. This tongue is not a relic of a former glaciation, but a definite variable extension of the Mackay glacier. We were able to make a very accurate measurement of the velocity of its flow. From Cape Geology I set the theodolite on a mark in the cliffs of the Kar plateau. These were about 5 miles to the north. Then Gran and I fixed a stake on the tongue exactly in the line of vision, a rather difficult problem owing to the crevasses. This was observed from time to time, and finally another direct measurement was made on the glacier tongue itself. The stake was found to have advanced 30 yards in the course of 30 days.

We spent nine weeks in the Granite harbour region; three of them being on Cape Roberts in expectation of relief by the ship. Debenham made a very fine plane-table survey of the vicinity, and many of his plans were done in great detail in connection with his stratigraphical work. We managed to climb to the inner glacier by "packing" everything on our shoulders up the Flat Iron. From here we proceeded inland to Mount Suess, which we climbed. The Devonian fish plates were found here in Beacon sandstone, and also many specimens of coal and plant stems. Perched blocks, polished and striated pavements, roches moutonnées, *debris* cones, etc., all made it the most interesting spot I visited in the Antarctic.

On January 6 we turned back from Mount Suess, and in a few days regained our headquarters at Cape Geology by way of the Flat Iron. I remember one photograph from the latter as of especial interest. It was an epitome of the physiography of the region, for it showed the following features: The ice face, the crevasses, the skauk, the young calved bergs, low-level moraines, the retreating glacier, high-level moraines, granite pavements, shear cracks torn in the sea-ice, the ice-tongue, the faceted cliffs, cwm valleys, overflow glacierets, hogback ridges, non-glaciated peaks, the old glacier flood-floor, and the junction of the granite and dolerite. All this on a single ¼-plate negative! (See Plate II. (*a*)).

Smaller Types of Glaciers.—Col glaciers. Some description of these has been given in connection with the col connecting the Ferrar and Taylor glaciers. In this example the ice-divide below Knob mountain is about 3000 feet elevation, and drops to 2000 feet within about 4 miles either way (see Fig. 6).

(*a*) LOOKING EAST DOWN THE LATERAL MOAT TO LAKE BONNEY, ON THE SOUTH SIDE OF SNOUT OF TAYLOR GLACIER.

(*b*) THE NEW GLACIER SWEEPING ROUND THE BACK OF PUNCH BOWL CWM. THE KNOB ON THE RIDGE IS THE DEVIL'S THUMB, 800 FEET HIGH. [*Debenham Photo.*

(*c*) LOOKING SOUTH ACROSS A TARN ON THE "FLAT IRON" TO THE COULOIRS ON MOUNT ENGLAND, IN THE SOUTH-WEST CORNER OF GRANITE HARBOUR.

PLATE I.

(*a*) A VIEW FROM THE "FLAT IRON" LOOKING NORTH, AND SHOWING THE ICE-FLOOD FLOOR OF THE KAR PLATEAU. THE MACKAY ICE TONGUE ENTERING SEA-ICE.

(*b*) A GLACIERET AND DÉBRIS CONES ON THE RAMP BEHIND THE CAPE EVANS HUT. THE ICE-AXE IS STRUCK IN A SOLIFLUCTION CRACK WHICH EXTENDS INTO THE LARGEST CONE.

(*c*) ICE-DAMMED LAKELETS ON THE SOUTHERN CLIFFS OF CAPE EVANS.

PLATE II.

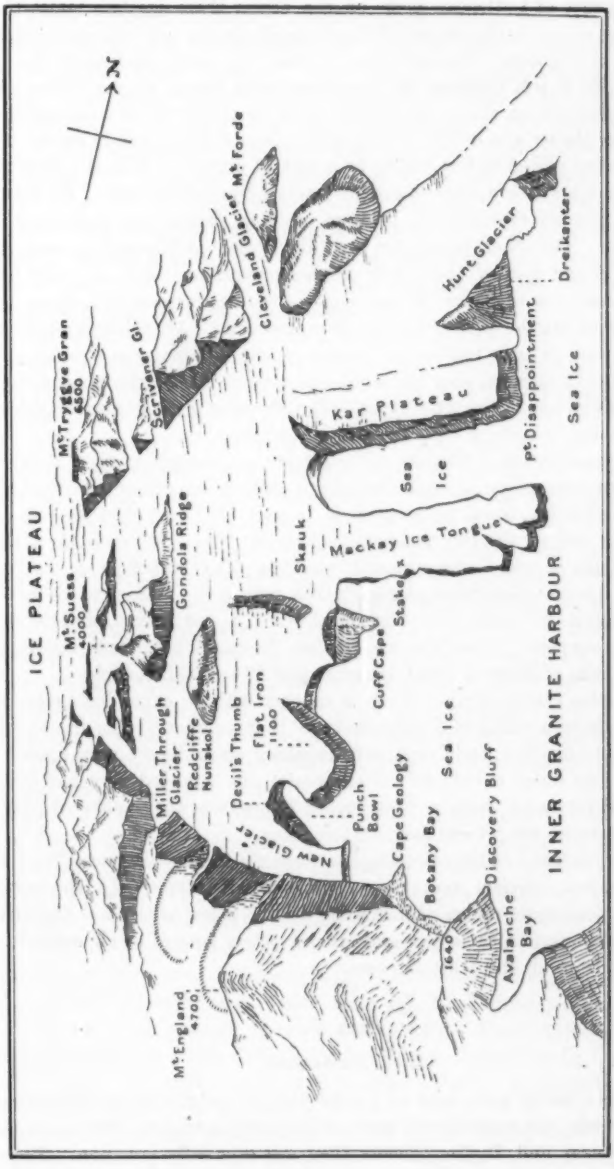


FIG. 18.—MAIN PHYSIOGRAPHIC FEATURES OF THE MACKAY GLACIER AND GRANITE HARBOUR, SHOWING NUNATAKKER, NUNAKOLLER, ICE-FLOOD FLOOR, FACETS, CWMS AND MACKAY ICE-TONGUE (LOOKING WEST).

Just east of Cathedral rocks on the Ferrar there are two interesting examples of the earlier stages of this type of glacier. A lobe of the Blue glacier, undoubtedly originating as a cwm, has eaten back until only a thin divide is left between itself and the main Ferrar glacier. This has in two places been covered by small outflows of ice, which have reached the main glacier about 1000 feet below. One of these merely covers the steep valley slopes of the Ferrar as a sort of curtain. This is "Descent pass," down which Armitage and his party glissaded in 1903. We found it tremendously crevassed in 1911, so much so that it was impossible to ascend it. The other constitutes the "Overflow," and occupies a remarkable deep and narrow gorge with almost precipitous sides. I could not get a close view of it, but it had some of the appearance of a water-cut gorge, and would repay further investigation. At these ice-divides bifurcations occur as real as the famous example linking the Orinoco and Amazon. In glaciers, they are much commoner, but the glaciers so linked are as distinct as in the river types. The Ferrar is quite distinct from the Blue glacier, in spite of the "Overflow" uniting them.

"*Expanded Foot*" *Glaciers.*—These form an interesting type, because they represent glaciers whose supply is still in excess of the wastage through ablation, thaw, or removal in bergs. The two chief glaciers on the north wall of the Dry valley belong to this type. We gave them the names Canada and Commonwealth glaciers. They debouch on the flat boulder-strewn valley from gorges about a mile wide. The grade is fairly steep—about 20° from the horizontal,—and is, of course, marked by strong crevasses. When the ice reaches the plain it spreads out to a circular cake of about 2 miles diameter and 30 to 100 feet high.

The Blue glacier further south is another with an expanded foot. It expands from a width of 2 miles to twice that amount. The front edge is probably floating, and bergs were breaking off while we were crossing it. But the water is evidently shallow—for one stranded berg had been separated for many seasons, if one could judge from the weathered edges of the fracture, and yet was only 100 feet away.

The variability of the alimentation accounts for the presence of a few expanded-foot glaciers among so many recessive types. In the same way in a temperate region of increasing aridity, a few of the best supplied rivers will maintain their flow and erosive power long after all water has vanished from all the other streams.

Part V.

Dendritic Glaciers.

This is a useful term used by glaciologists to include the smaller tributaries entering the main stream more or less at right angles. On the slopes of the Ferrar and Taylor glaciers they are especially common. These slopes have a remarkably uniform angle of about 33°. I imagine that this

is due less to the planation by the giant glacier-plough than to the action of King Frost. It is, in fact, near the "angle of slope" of *débris* loosened by frost action, and is a sort of "basal surface"; for the *débris* is to some extent preservative when it covers a slope. I believe that this sort of frost action can give rise to the type catenary curve of glacial valleys; and that to a great degree the glacier-ice acts as a sort of "template" directing the sapping forces of frost and water. We have an analogy in the "*scour-wall*" built out in harbours, so that the tide and river flow may keep a channel clear where the wall directs the flow of water and ensures efficient action. So the glacier wall, even when separated from the land by a lateral moat, directs the frost and water action which are the dominant factors of erosion in a receding glaciation.

The small tributary glaciers are usually about a mile long in the regions specified above. They are distributed with some regularity about 1 or 2 miles apart, all round the Kukri hills and on the valley walls opposed to these hills. During their course they descend from 3000 to 4000 feet, and in the majority of cases do not reach the main valley.

Seen from a height some distance away the firn field in which they rise—for instance, the top of the Kukri hills—is seen to be approximately level, but crossed by rather steep narrow ridges running at right angles to the main glaciers. These would appear to represent the latter stages in the dissection of an upland region by cwms as portrayed by Nussbaum.

The smaller glaciers may be divided into gorge glaciers, slope glaciers, and cliff glaciers, according to their mode of entry into the valley. The *gorge* glaciers enter practically at grade, and are, of course, more important than the other types. It is difficult to separate some of these varieties. For instance, the two striking gorge glaciers entering the Lower Ferrar on the 163rd meridian were determined by a belt of softer limestone. These are the Kitticarrara and Overflow glaciers. Near Cathedral rocks are several more of this type (see Fig. 6).

The *slope* glaciers are characteristic of the southern side of the Taylor and Dry valleys. They reach down almost to the middle of the empty bed of the Taylor glacier in the fôrm of broad lobes. They merge into cliff glaciers on the one hand, and into gorge and expanded-foot glaciers on the other. Examples are the Hughes, Marr, and Sollas glaciers (see Fig. 6).

There are smaller glaciers which hang down the 33° walls and do not reach the lower slopes. These are *cliff* glaciers. The larger are in the form of curtains flung over the shoulder of the valley. There are some striking examples near the mouth of the Ferrar glacier. They cut through the actual shoulder by a broad saddle-shaped hollow. Occasionally the glacier barely leaves this hollow, and these "*saddle*" glaciers (such as the Wales glacier) are common in Dry valley.

Some of the long, narrow cliff glaciers are broken in two—the lower portion being fed by small avalanches. These approach Hobbs' *reconstructed* glaciers. We examined one at the west end of the Kukri hill,

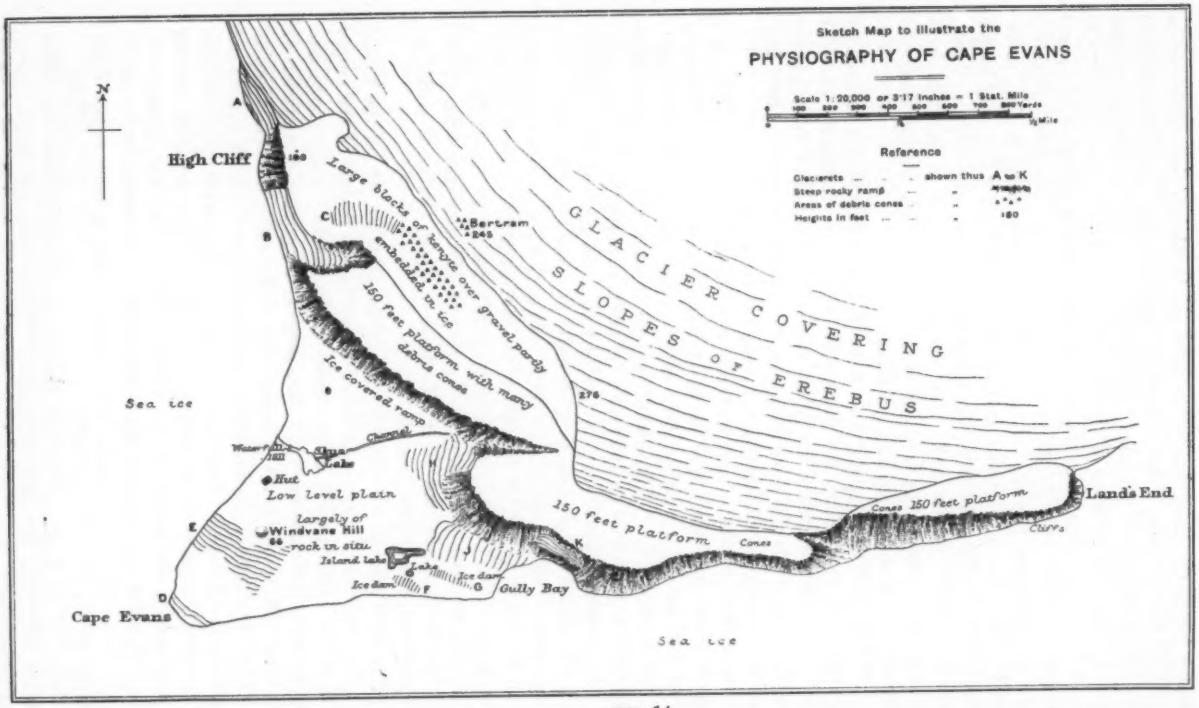

Sketch Map to illustrate the
PHYSIOGRAPHY OF CAPE EVANS
Scale 1: 20,000 or 3·17 inches = 1 Stat. Mile
Reference
Glacierets ... shown thus A to K
Steep rocky ramps ... "
Areas of debris cones ... "
Heights in feet ... " 180
N
High Cliff
Large blocks or bowlders over gravel pardy embedded in ice
Bertram
150 feet platform with many debris cones
Ice covered ramp
GLACIER COVERING SLOPES OF EREBUS
Sea ice
Water Fall
Channel
Blue Lake
Hut
Low level plain
Largely of rock in situ
Windvane Hill
Island Lake
Ice dam
Ice dam
Gully Bay
Cape Evans
150 feet platform
Cones
Cones 150 feet platform
Cliffs
Land's End
Sea ice

FIG. 14.

and a larger example occurred near the Bonney riegel just east of the Taylor glacier.

Tabulating these tributaries in the Lower Ferrar and Dry valleys —all to the east of Knob head—we get an interesting comparison.

Type.	Name.	Reaching main valley.	Hanging.	Total.
A. GRADED				
Expanded foot type	Commonwealth, Canada	2	—	2
Gorge type	Kitticarrara, etc.	5	—	5
Slope type	Sollas, Marr, etc.	10	—	10
B. NOT AT GRADE				
Saddle	Wales, etc.	—	4	4
Curtain	Double Curtain	—	6	6
Cliff	Herbertson, Hedley	9	18	27
	Total ...	26	28	54

These may be taken as typical of the glaciers in these latitudes. About 15 per cent. have cut gorges, while (in these two outlet glaciers) about half reach the middle of the main valley; or the main glacier—when the latter is present.

The initiation of a glacier is illustrated in almost every headland or patch of bare rock. I remember walking along the coast just north of Shackleton's quarters and seeing above me a great cliff of ice—apparently the face of a glacier about 100 yards across. On ascending the cliffs at the side—this "glacier" was seen to be only about 100 feet deep. It was merely an ancient snow-drift which occupied a niche in the cliffs and had turned to ice *in situ*. But on Cape Evans were many examples of these metamorphosed snow-drifts. From the geologist's point of view they were real glaciers. I called them *glacierets* (see Plate II. (*b*)).

These drifts grew in suitable localities in the lee of small hills, and were not only built by the blizzards, but were pruned by the blizzards. The latter swept them bare and regularly polished the ice surface when an optimum size was reached. A sketch-map annexed—from a plane-table survey by Debenham and myself—gives the size and shape of some typical glacierets (see Fig. 14).

(*To be continued.*)

FIG. 14.

THE ALLEGED DESICCATION OF EAST AFRICA.

By C. W. HOBLEY, C.M.G.

THIS question has been the subject of considerable verbal discussion in the country itself, but very little has been written on it. The evidence for the alleged desiccation of the globe was, however, the subject of a

recent learned paper by Prof. J. W. Gregory in the *Geographical Journal* for March, 1914, and it has occurred to me that it would be useful to record the evidence on the subject which has come to my notice in British East Africa and other places on the east side of the continent.

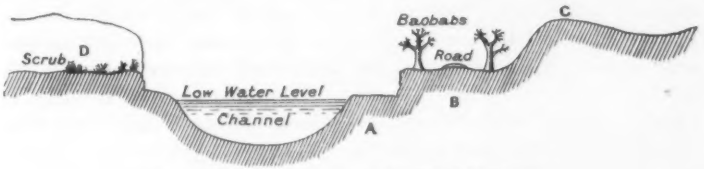
Generally speaking, it is believed that very marked evidence is available that considerable desiccation of this part of the continent has taken place from late Tertiary times down to the present day. To commence at the coast, it is undoubtedly the fact that the whole of the coast-line from the German border to, say, Kismayu shows undoubted signs of elevation in recent times. Take Mombasa island, for instance; one there finds the recent coral reefs raised to a height of 70 feet above sea-level, but at the entrance to Kilindini harbour (Mombasa) there is more than that: on the island, some 200 feet back from the edge of the present coral cliff, there is another cliff which evidently marked the width of the channel in, say, Pleistocene times; in the opposite direction a third cliff is just emerging from low water level.

Now, I believe that it can be safely asserted that the width of a channel through a coral barrier usually depends on the amount of fresh or semi-fresh water discharged through it, the mixture of fresh water with the salt checking the growth of the reef. I therefore believe that when the cliff marked C was the boundary of the tidal channel, the volume of fresh water discharged into the upper waters of the harbour was much greater than it is to-day; similarly, when the cliff B bounded the water-channel, the volume of fresh water was greater than at present, when a new cliff A is being formed which can be clearly seen at low tide. The greater volume of fresh water would also bring down mud which is generally recognized as being a factor that checks the growth of coral. This theory is borne out by the large amount of erosion which is visible in the cañons of the Mwachi and Manolo rivers, which even now in flood-time discharge a considerable amount of fresh water into the head of Port Reitz. The amount of fresh water, however, at any season bears a very small proportion to the enormous volume of salt water which flows into and out of Port Reitz and Kilindini harbour. The Andromache reef and the reef to the north of the port correspond in age to the semi-submerged cliff A, which is just showing above sea-level.

At the time when cliff C formed the north boundary of the channel, the reef marked D was awash and in the same position as the Andromache reef to-day, the south wall of the sea channel being further back. At Shimoni station, opposite Wassin, there are large underground caves in the coral rock, the ramifications of which extend a considerable distance; in one of the caves there is still a tiny brackish spring, and this gives a clue to their formation, for, as far as I can judge, they can only have been formed by the presence of springs of fresh water which bubbled out at sea-level, and wherever they occurred prevented the coral insect from working in the vicinity; the volume of these springs gradually decreased,

and the coral insect built over the top, leaving these winding galleries through the heart of the reef. The springs have now almost disappeared.

As we proceed north up the coast we obtain evidence of another character and of more recent times. The coast-line from Wasin to Kismayu is studded with ruined towns. South of Mombasa they do not appear to be so common as to the north, although there are quite a number to be found in the dense bush along the coast-line at Shirazi and immediately south of Mombasa island. Immediately north of Mombasa there are ruins at various places between Mombasa and Malindi, notably at Kilifi, Gedi, and



Section of entrance to Kilindini Harbour

Mida; near Malindi itself there are traces of large settlements, and again at Shesheli, Ngomeni, and on towards Lamu. Between Kismayu and Port Durnford there are said to be 60 miles of coast full of ruins, and again north of Port Durnford and on the islands of the north portion of what is called the Lamu archipelago there are innumerable ruins of stone buildings, absolute evidence of a dense population. No record remains of these people, but they are commonly supposed to have been early Persian settlers, and the settlements seem to have been formed since the establishment of the Mohammedan religion, for there are numerous remains of well-built stone mosques with the typical Moslem Kiblah (or shrine) on the north side towards Mecca, ruined arches, myriads of stone graves of the Moslem type, and so forth.

Only careful excavation can, however, settle who these people originally were; we have no record of the foundation of such extensive Arab settlements as this, and I am inclined to believe that they may date back as far as Himyaritic times, and be an offshoot of that great civilization which built the huge dam at Mareb in South Arabia and excavated the Aden tanks. There is some reason for the belief that the tribes of the interior were influenced at a remote period by Semitic beliefs, pre-Mohammedan in point of time, and this influence may have emanated from these settlements; the Mohammedan mosques and graves being products of the culture superimposed by Arab conquerors. In some places, if we examine the maritime plain in the vicinity, the limits of their cultivated fields can be seen, for land which has been cultivated for a considerable period and then abandoned carries a different flora to land covered by primæval bush or forest; but wherever I have had the opportunity of examining the area of the previously cultivated

strip, it would not prove a *raison d'être* for the presence of the old population.

Now, knowing the congestion of the average Eastern settlement, there is no doubt that the population which built these towns must have been very considerable, and the question arises as to what they were doing there, and what they were living on. Presumably the glib reply will be that they were trading for ivory, apes, and peacocks. The ivory trade probably was considerable; but I imagine that the apes and peacocks did not figure very largely in their customs returns, to say nothing of the fact that the peacock is an Asiatic bird, although some ingenious commentator has suggested that the term "peacock" really referred to the African guinea-fowl. I am inclined to believe that these settlements really thrived on the cattle and live stock trade with the tribes of the interior, and for the following reason. In the Somali hinterland there are also evidences of a much greater population, and it is highly probable that they were great pastoral people, for the country is naturally not an agricultural area, but pre-eminently a stock country. Around Wajheir, in Jubaland, to-day large numbers of artificial mounds are to be found, many of them as much as 30 feet in height, and these are, it is believed, the funeral mounds of an extinct race. The Hon. K. Dundas opened one of the smaller ones. He found a few fragmentary bones, unfortunately no human ones, but he discovered what appears to be a rude copper bracelet; as there is no copper found naturally in that country, this betokens trade and intercourse with the coast, and with people who had copper to sell.

These mounds are so numerous, and in addition the large number of well-excavated wells, often over 40 feet deep, and the traces of artificial dams, all go to prove that this area, which is now practically a desert, once carried a large and organized population. It is now only inhabited by a limited population of nomad Somalis, who move about from waterhole to waterhole and graze their stock as long as the water lasts. Similar mounds are found throughout the Nyika belt as far south as Taru, on the Uganda railway, but south of Wajheir they become much smaller, and rarely average more than a few feet in height.

The Somalis say that the wells and the mounds were made by the Maanthinle people. This name in the Somali language means the tall people; possibly they consider that people who carried out such works must have been of superhuman stature.

In the evidences of the population of the hinterland we have, it appears to me, an explanation of the settlements on the coast, and as to their disappearance, I put this down to the desiccation of the country. There is no record of these settlements having been systematically destroyed by invasion, and even if the coast dwellers were annihilated, it is difficult to see how the tribes of the interior could have been exposed to similar attack.

N
Sketch of the Entrances to MOMBASA and KILINDINI HARBOUR to illustrate a paper by C.W. HOBLEY on the alleged desiccation of EAST AFRICA
Scale 1:30,000
0
Mile
MOMBASA
English Pt
Entrance to Mombasa deep water at all tides
MOMBASA TOWN
Harbour
Mackenzie Pt
Fort
Cliffs 30 ft
ISLAND
Lagoon
Reef exposed at Low Tide
Ras Serani
Eroded cliff 25-35 ft
Reef exposed at Low Tide
Cliffs 30 ft
Entrance to Kilindini Harbour deep water all tides
Cliffs 30 ft
Andromache Reef
Exposed at Low Tide
Reference
Represents present width of opening in coral reef
An older and wider opening in reef
An older and still wider opening in reef

We know that in about the year 1589 a terrible horde of savages, called the Mazimba, swept up the east coast and destroyed Kilwa and nearly destroyed Mombasa; this force swept on up the coast, but were, according to the records, finally defeated at Malindi by Mattheus Mendes de Vasconcellos with a number of Portuguese soldiers, the Arabs, and some 3000 Bantu tribesmen recruited in the vicinity and said to be Wa Segeju. This invasion may account for the comparative scarcity of ruins south of Mombasa, but it cannot account for the abandonment of the settlements between Lamu and Kismayu. The trade of these coast settlements was, I believe, the supply of domestic animals for meat during the south-west monsoon, to the at that time comparatively dense population in south Arabia.

STONE CAIRN ON TANA RIVER, BETWEEN THAKA COUNTRY AND KOROKORO; THE TOP OF THE CAIRN IS CONCAVE.

(*E. Battiscombe, photo*, 1909.)

In connection with the presumed desiccation of the country west of Lamu and Kismayu I may mention the drying up of Lake Stefanie. When Count Teleki and Höhnel visited it in 1888 it was a definite lake of large dimensions; when Donaldson Smith visited it in 1884 it was rather larger than in Teleki's day; but of recent years it has become little more than a big puddle holding a certain amount of water during the rains. I do not, however, attach great importance to this evidence, as it extends over too short a period of time. Never having visited Lake Rudolf, I cannot adduce any direct evidence as to whether it exhibits traces of desiccation, but one fact strikes one, and that is that the Teleki volcano at the south end of the lake, which was very active in 1888, is now quite extinct, and this, I am inclined to think, may be due to the recession of waters of the lake, as the steam generated by the infiltration of lake water may have afforded motive power for its eruptions.

To change the scene of our inquiry, let us proceed up country for a little. There are undoubted evidences of the greater extent of Lake Naivasha within geologically recent times; Prof. Gregory, too, gives evidence as to the existence of a great lake he names after Prof. Suess, in the Rift valley, south of Naivasha; Lake Magadi is, I believe, the attenuated relic of a sheet of water of much greater extent. Mr. J. Parkinson, in his paper in the *Geogr. Journal* (July, 1914), has shown that in Post-Pliocene times Lake Magadi was once a sheet of water of much greater extent than the area covered by the soda deposits at the present day, and he further states as follows: "Evidence is afforded by this district, *i.e.* the Rift valley, of a general desiccation: the periodical floods of the Turoka river are not adequate for the formation of such a gorge as that now seen, and we have in addition the disappearance of Lake Suess. The old alluvial fans of Lorgosalich, now overgrown by vegetation, point to torrential rains being more frequent at an earlier period."

Lake Nakuru probably once also extended much further to the south than it does to-day. There is little doubt that the Lakdera river, which is the dry watercourse which emerges from the east end of Lorian swamp, and which can be traced down to the Deshek Wama lake and so to the Juba river, was once a real river and a tributary of the Juba; nowadays it can hardly be called a river except for the fact that water can be found in wells at certain places along its course, and thus there is an underground seepage of water which is fed from the Uaso Nyiro after every rainy season. The Lorian swamp, too, turns out to be much smaller than was originally reported, but of course the original reports were very vague. Deshek Wama lake only carries water once in every few years, and that is almost certain to be either surface water from the surrounding country or flood water from the Juba.

If, as is believed in times past, the Lakdera was a considerable river with a belt of thick forest on its banks, this might have exercised some small effect on the climate of the surrounding area. Jilore lake, near the Sabaki river, which was quite a considerable sheet of water up to recent years, has been steadily diminishing, and is now quite dry, and the site is covered with scrub. This may, however, be due to the Sabaki river, which fed the lake to a great extent, having cut its channel below the level of the inlet to the lake. Baratumo lake, on the south of the Sabaki river between Jilore and Malindi, is also said to be now dry.

Proceeding west over the Mau escarpment we descend to Lake Victoria, and there we find definite evidences that that lake once extended eastwards as far as Muhoroni, roughly 400 feet above present lake-level, and it was probably the waters of the lake which, converted into steam, afforded the motive power that broke down the crater wall of the great volcano now called Tinderet. I doubt if this fall of the level of Lake Victoria is entirely due to the wearing away of the sill of the natural dam formed by the

granite dyke at Jinja, known as the Ripon falls; I am inclined to believe that the decrease in rainfall has had a greater effect.

The German authorities inform me that Lake Rukwa at the south-east corner of Lake Tanganyika has much decreased in size during the last fifty years, and that the western portion of it has practically disappeared and become swamp; they also state that the marks of the old water-levels on Lake Nyasa are now many feet above the present water-level. This may of course be due to the wearing away of the sill where the Shire river leaves the lake. To go further afield, we know that in Livingstone's day Lake Ngami was an open sheet of water, and is now nothing more than a swamp; but these examples may be considered too remote from the area under consideration to be of any weight. According to the Duke of Mecklenburg, the salt lake of Katwe in South Toro is drying up, and the salt deposits may be seen several yards above the present lake-level. This is probably due to desiccation in historic times, as sodium chloride is such a soluble salt.

One must exercise great caution in an inquiry of this kind to separate evidence of a geological character from evidence of what may be termed a historical character, because in dealing with the two classes of evidence one is thinking in different terms. It must be borne in mind that our accurate meteorological records in these parts of Africa only go back some twenty-five years, and in that period no great decrease of rainfall is marked. The evidence of the coast settlements above quoted goes back probably some six hundred years, and may go back much further, for, as has been mentioned, it is possible that they date back to the zenith of the Himyaritic civilization in South Arabia; the fact that there are ruined mosques may not prove that these erections were coincident with the foundation of the settlements. For all this, however, there is a great jump from historic times to the later Tertiary age, when the Rift valley was in an unstable condition owing to volcanic disturbance, but there is nothing to show that the conditions which set in then have not continued up to the present era.

After having stated a problem it is always considered advisable to propound a plausible solution, and it is here that I fear I shall fail to satisfy the critic. There are, however, a few points in this connection which should be set forth. One is the great decrease of the area under forest in the higher parts of East Africa, particularly in the Kikuyu region, *i.e.* the south-south-west slopes of Kenya and on the Aberdare ridge, during historic times. Owing to the increase of population and the consequent greater demand for agricultural land during the last hundred to two hundred years or so, it is estimated that the area of forest has artificially been decreased by some 3000 square miles. The rain-borne clouds sweep westward over the continent, and when chilled by the belt of forest on the higher ridges deposit their rain on the western slopes; this would afford a reasonable explanation of a decrease in rainfall in a

certain portion of the Rift valley during that period. It would, however, afford little explanation of the desiccation of the hinterland of Jubaland between Kismayu and Lake Rudolf.

Another point which has been suggested is that the rate of elevation of the interior of British East Africa has been in excess of the rate of denudation, so that in effect the rainfall has run off so quickly that it has not had time to permeate the soil of the area on which it falls; this point is, however, I consider, without any support. There is definite evidence that the glaciation over Mount Kenya extended in Pleistocene times to a much lower level than it does at present, and there is little doubt that this state of affairs had a considerable effect on the climate of a great portion of this part of Africa; or, to express it more logically, that the conditions which produced a more extensive glaciation on Kenya also considerably affected the climate of the country generally, and the lower general temperature of this part of the continent would probably cause greater precipitation of rain. As Prof. Gregory, however, points out with great acumen, the coastal raised beaches and reefs give no palæontological evidence of contemporary reduction in the temperature of the adjacent ocean.

Prof. Gregory found traces of former glaciation on Kenya over 5000 feet below the present lowest terminal level of the ice, and he goes on to argue that this was due to a much greater elevation of the Kenya area. The present peak of Kenya is the denuded core of a volcano which probably at one time presented a dome-like shape somewhat on the same lines as the Kibo peak of Kilimanjaro; the sister peak of Kilimanjaro, Mawenzi, may be said to be in the same stage of decay as Kenya. Mawenzi is about 2000 feet lower than Kibo, and so we can, for the purpose of argument, add 2000 feet to the height of Kenya and obtain a rough estimate of its original altitude; the extra area of the ice-fields under these conditions would doubtless partially account for the traces of glaciation at a lower level.

Dr. Rocatti, the geologist to the Abruzzi expedition, observed traces of glacial action on that mountain on the east side, at 4870 feet above sea-level; the lowest level of the existing ice is now about 13,680 feet, an astounding recession of 8780 feet. The climate at the time this vast area of snowfield existed on mountains like Kenya and Ruwenzori must have been extraordinarily unlike present-day conditions.

The botanical evidence available, however, shows that a more or less common alpine flora is to be found on all the high mountains from Abyssinia to Kilimanjaro, and this flora is quite unlike anything to be found in the intervening country. This fact tends to show that at one time, and, speaking geologically, at a not very distant period, there was a continuous connection of land at a high level between these points so remote. Gregory estimates that at that time the mean temperature must have been at least 17° lower than at present. Now the prevailing

winds on the coast are the north-east and south-west monsoons, which blow periodically parallel with the coast in one direction or the other according to the seasons. Up country, at an elevation of a few thousand feet, the changes in the monsoon are not felt, but over the bulk of the year a strong wind, generally easterly and a little south of east, blows during the greater part of the day, and it is believed that these are the trade winds blowing high over the monsoon winds which keep near coast-level. It is very marked on the big mountains in the interior, such as Kenya, Kilimanjaro, and Elgon; in the early morning they are generally quite clear, but about 10 a.m. the clouds sweep up from the south-south-east and collect on the mountains and blot them out from view for the rest of the day. These are believed to be clouds borne inland by the trade winds, and the moisture they carry is precipitated mainly on the south and south-east slopes; the proof this precipitation exists in the much greater growth of forest on the south and south-east sides of the mountains referred to. Now, when there was a continuous ridge of high land between Abyssinia and Kilimanjaro this precipitation must have been enormous, and an enormous amount of water must have flowed eastwards towards the Indian ocean.

Prof. Gregory also produces arguments with regard to the effect of the variation of lines of atmospheric pressure which would be caused by the greater elevation of a large area, and which he claims would greatly increase the rainfall and widen its distribution. I am, however, inclined to doubt whether the information as to the position of the isobaric lines, *i.e.* lines of equal barometric pressure, is sufficiently accurate to build upon, although this would of course not necessarily affect the principle of the argument.

Several other explanations have been adduced by geologists to account for periodic variations in climate, and variations in rainfall would follow. One of these, which has from time to time attracted considerable attention, is that the main contributory cause is the variation in the carbonic acid contents of the atmosphere. There is little doubt that in earlier geological times the proportion of free carbonic acid gas was much greater in the atmosphere than at present; all the great coal deposits of the world are built up of carbon from the atmosphere, and it is alleged that the enormous deposits of limestone in the Earth's crust, which contain many times more carbon than all the coal deposits put together, although primarily they obtained their carbon from the sea, absorbed a great portion from the air. The evidence, as far as it goes, appears to prove that the oceans are the greatest governors of the proportions of carbonic acid gas in the atmosphere, and it is calculated that an increase of 0·06 of carbonic acid gas in the atmosphere would cause a rise in the average temperature in the Polar Regions of some 14° Fahr., the idea being that a reduction in the carbonic acid gas contents cools the climate and an increase causes the reverse.

Now, extensive volcanic action is known to produce vast amounts of carbonic acid gas, but the great volcanic activity of Pleistocene times does not seem to fit in altogether with the greater extent of the Kenya glaciers about that period. I believe, however, that extensive volcanic activity is usually attended by temporary torrential rainfall, partly due to the condensation of great masses of steam, and this would probably dissolve the greater portion of the extra free carbonic acid gas. Thus taking every factor into consideration, the most hopeful course would appear to be to search for some cause to account for a gradual change in the routes of atmospheric circulation. The usual cause for such variation is a different distribution of land and water; in this case, however, there appears to have been no change that can count.

I am not enough of a meteorologist to say whether there are any other theories as to why the monsoons or trade winds should have carried less moisture over the continent during historic or recent geological times, but the evidence remains as I have stated it, and my only hope is that some one may be able to pursue the question a stage further and produce some logical explanation of the problem I have endeavoured to expound.

MAN AS A GEOGRAPHICAL AGENCY.*

By Sir CHARLES P. LUCAS, K.C.B., K.C.M.G.

In an inaugural address to the Royal Scottish Geographical Society on Geography and Statecraft Lord Milner said: "If I have no right to call myself a geographer, I am at least a firm believer in the value of geographical studies." I wish to echo these words. I have no expert geographical knowledge, and am wholly unversed in science, but I am emboldened to try and say a few words because of my profound belief in the value of geographical studies. I believe in their value partly on general grounds, and largely because a study of the British Empire leads an Englishman, whether born in England or in Australia, to the inevitable conclusion that statecraft in the past would have been better if there had been more accurate knowledge of geography. This statement might be illustrated by various anecdotes, some true, not a few apocryphal; but anecdotes do not lend themselves to the advancement of science. I am encouraged, too, to speak because the field of geography is more open to the man in the street than are the sciences more strictly so-called. It is a *graphy*, not a *logy*. Geology is the science of the earth. Geography is a description of the face of the earth and of what is on or under it, a series of pictures with appropriate letterpress and with more or less appropriate morals to adorn the tale. The man in the street may talk affably and even intelligently about the face of the earth.

Taking the earth as it is, geographical discovery has well-nigh reached its limit. The truth, in the words of Addison's hymn, is now "spread from Pole to Pole," and recent exploration at the South Pole, with its tale of heroism, will have specially appealed to the citizens of this Southern land. Coasts are in most

* Presidential Address to the Geographical Section, British Association, Australian meeting, August, 1914.

cases accurately known. The age of Cook and Flinders is past. Interiors are more or less known. In Africa there is no more room for Livingstones, Spekes, Burtons, and Stanleys. In Australia Sir John Forrest is an honoured survival of the exploring age—the age of McDouall Stuart and other heroes of Australian discovery. The old map-makers, in Swift's well-known lines, "o'er unhabitable downs placed elephants for want of towns." Towns have now taken the place of elephants and of kangaroos. Much, no doubt, still remains to be done. The known will be made far better known; maps will be rectified; many great inland tracts in Australia and elsewhere will be, as they are now being, scientifically surveyed; corners of the earth only penetrated now will be swept and garnished. But as we stand to-day, broadly speaking, there are few more lands and seas to conquer. Discovery pure and simple is passing away.

But meanwhile there is one side of geography which is coming more and more to the front, bringing it more than ever within the scope of the British Association for the Advancement of Science. "Man is the ultimate term in the geographical problem," said Dr. Scott Keltie some years since at the meeting at Toronto. "Geography is a description of the earth as it is, in relation to man," said Sir Clements Markham, long President of the Royal Geographical Society. Geography, I venture to think, is becoming more and more a description of the earth as it is and as it will be under the working hand of man. It is becoming intensive rather than extensive. Geographers have to record, and will more and more have to record, how far man has changed and is changing the face of the earth, to try and predict how far he will change it in the coming centuries. The face of the earth has been unveiled by man. Will the earth save her face in the years before us, and, if she saves her face, will it be taken at face value? How far, for instance, will lines of latitude and longitude continue to have any practical meaning?

Man includes the ordinary man, the settler, the agriculturist; man includes, too, the extraordinary—the scientific man, the inventor, the engineer. "Man," says a writer on the subject, "is truly a geographical agency," and I ask you to take account of this agency for a few minutes. I do so more especially because one of the chief features of the present day is the rise of the South; and the rise of the South—notably of Australia—is the direct result of human agency, on the one hand transforming the surface of the land, on the other eliminating distance. The old name of Australia, as we all know, was New Holland. The name was well chosen in view of later history, for while no two parts of the world could be more unlike one another than the little corner of Europe known as Holland, or the Netherlands, and the great Southern Continent, in the one and in the other man has been pre-eminently a geographical agency.

The writer who used this phrase, "Man is a geographical agency," the American writer, Mr. G. P. Marsh, published his book, 'Man and Nature,' in 1864, and a new edition, entitled 'The Earth as Modified by Human Action,' in 1874. He was mainly concerned with the destructiveness of man in the geographical and climatic changes which he has effected. "Every plant, every animal," he writes, "is a geographical agency, man a destructive, vegetables, and in some cases even wild beasts, restorative powers"; and again: "It is in general true that the intervention of man has hitherto seemed to ensure the final exhaustion, ruin, and desolation of every province of Nature which he has reduced to his dominion." The more civilized man has become, he tells us, the more he has destroyed. "Purely untutored humanity interferes comparatively little with the arrangements of Nature, and the destructive agency of man becomes more and more energetic and unsparing as he advances in civilization." In short, in his opinion, "better fifty years of Cathay than a cycle of Europe."

He took this gloomy view mainly on account of the mischief done by cutting down forests. Man has wrought this destruction not only with his own hand, but through domesticated animals more destructive than wild beasts, sheep, goats, horned cattle, stunting or killing the young shoots of trees. Writing of Tunisia, Mr. Perkins, the Principal of Roseworthy College, says: "In so far as young trees and shrubs are concerned, the passage of a flock of goats will do quite as much damage as a bush fire." Mr. Marsh seems to have met a fool in the forest, and it was man; and he found him to be more knave than fool, for man has been, in Mr. Marsh's view, the revolutionary Radical confiscating Nature's vested interests. "Man," he says, "has too long forgotten that the earth was given to him for usufruct alone, not for consumption, still less for profligate waste." Trees, to his mind, are Conservatives of the best kind. They stand in the way, it is true, but they stop excesses, they moderate the climate, they give shelter against the wind, they store the water, prevent inundations, preserve and enrich the soil. "The clearing of the woods," he says, "has in some cases produced within two or three generations effects as blasting as those generally ascribed to geological convulsions, and has laid waste the face of the earth more hopelessly than if it had been buried by a current of lava or a shower of volcanic sand"; and, once more, where forests have been destroyed, he says, "the face of the earth is no longer a sponge, but a dust-heap."

The damage done by cutting down trees, and thereby letting loose torrents which wash away the soil, is or was very marked in the South of France, in Dauphiné, Provence, and the French Alps. With the felling of trees and the pasturing of sheep on the upper edge of the forest—for sheep break the soil and expose the roots—the higher ground has been laid bare. Rainstorms have in consequence swept off the soil, and the floods have devastated the valleys. The mountain-sides have become deserts, and the valleys have been turned into swamps. "When they destroyed the forest," wrote the great French geographer, Reclus, about thirty years ago, "they also destroyed the very ground on which it stood"; and then he continues: "The devastating action of the streams in the French Alps is a very curious phenomenon in the historical point of view, for it explains why so many of the districts of Syria, Greece, Asia Minor, Africa, and Spain have been forsaken by their inhabitants. The men have disappeared along with the trees; the axe of the woodman, no less than the sword of the conqueror, has put an end to, or transplanted, entire populations." In the latter part of the South African war Sir William Willcocks, skilled in irrigation in Egypt, and now reclaiming Mesopotamia, was brought to South Africa to report upon the possibilities of irrigation there, and in his report dated November, 1901, he wrote as follows: "Seeing in Basutoland the effect of about thirty years of cultivation and more or less intense habitation convinced me of the fact that another country with steep slopes and thin depth of soil, like Palestine, has been almost completely denuded by hundreds of years of cultivation and intense habits. The Palestine which Joshua conquered and which the children of Israel inhabited was in all probability covered over great part of its area by sufficient earth to provide food for a population a hundred times as dense as that which can be supported to-day." The Scotch geologist, Hugh Miller, again, attributed the formation of the Scotch mosses to the cutting down of timber by Roman soldiers. "What had been an overturned forest became in the course of years a deep morass."

In past times there have been voices raised in favour of the forests, but they have been voices crying in the desert which man has made. Here is one. The old chronicler Holinshed, who lived in the reign of Queen Elizabeth, noted the amount of timber cut down for house building and in order to increase the area

for pasturage. "Every small occasion in my time," he writes, "is enough to cut down a great wood"; and in another passage either he himself or one of his collaborators writes that he would wish to live to see four things reformed in England: "The want of discipline in the Church, the covetous dealing of most of our merchants in the preferment of commodities of other countries and hindrance of their own, the holding of fairs and markets upon the Sunday to be abolished and referred to the Wednesdays, and that every man in whatever part of the champaine soil enjoyeth forty acres of land and upwards after that rate, either by free deed, copyhold or fee farm, might plant one acre of wood or sow the same with oke mast, hazell, beach, and sufficient provision be made that it be cherished and kept."

Mr. Marsh seems to have thought that the Old World, and especially the countries which formed the old Roman Empire, had been ruined almost past redemption; and for the beneficent action of man on Nature he looked across the seas. "Australia and New Zealand," he writes, "are perhaps the countries from which we have a right to expect the fullest elucidation of these difficult and disputable problems. Here exist greater facilities and stronger motives for the careful study of the topics in question than have ever been found combined in any other theatre of European colonization."

His book was first written half a century ago. He was a pessimist evidently, and pessimists exaggerate even more than optimists, for there is nothing more exhilarating and consoling to ourselves than to predict the worst possible consequences from our neighbour's folly. Further, though it may be true that man became more destructive as he became more civilized, it is also true that the destruction has been wrought directly rather by the unscientific than by the scientific man. If we have not grown less destructive since, at any rate we have shown some signs of penitence, and science has come to our aid in the work of reparation. Governments and associations have turned their attention to protecting woodland and reafforesting tracts which have been laid bare. The Touring Club of France, for instance, I am told, have taken up the question of the damage done by destruction of trees by men and sheep in Haute Savoie, and they assist reclamation by guidance and by grants. In England, under the auspices of Birmingham University and under the Presidency of Sir Oliver Lodge, the Midlands Reafforestation Association is planting the pit mounds and ash quarries of the Black Country with trees which will resist smoke and bad air, alders, willows, poplars, carrying out their work, a report says, under a combination of difficulties not to be found in any other country. Artificial lakes and reservoirs, again, such as I shall refer to presently, are being made woodland centres. In most civilized countries nowadays living creatures are to some extent protected, tree planting is encouraged by Arbour days, and reserves are formed for forests, for beasts and birds, the survivors of the wild fauna of the earth. Some lands, such as Greece, as I gather from Mr. Perkins' report, are still being denuded of trees, but as a general rule the human conscience is becoming more and more alive to the immorality and the impolicy of wasting the surface of the Earth and what lives upon it, and is even beginning to take stock as to whether the minerals beneath the surface are inexhaustible. Therefore I ask you now to consider man as the lord of creation in the nobler sense of the phrase, as transforming geography, but more as a creative than as a destructive agency.

How far has the agency of man altered, and how far it is likely to alter, the surface of the Earth, the divisions and boundaries assigned by Nature, the climate, and the production of the different parts of the globe; and, further, how far, when not actually transforming Nature, is human agency giving Nature the go by? It

should be borne in mind that science has effected, and is effecting, transformation, partly by applying to old processes far more powerful machinery, partly by introducing new processes altogether; and that, as each new force is brought to light, lands and peoples are to a greater or less extent transformed. The world was laid out afresh by coal and steam. A new readjustment is taking place with the development of water power and oil power. Lands with no coal, but with fine water power or access to oil, are asserting themselves. Oil fuel is prolonging continuous voyages and making coaling stations superfluous. But of necessity it is the Earth herself who gives the machinery for altering her own surface. The application of the machinery is contributed by the wit of man.

The surface of the Earth consists of land and water. How far has human agency converted water into land or land into water, and how far, without actually transforming land into water and water into land, is it for practical human purposes altering the meaning of land and water as the great geographical divisions? A writer on the Fens of South Lincolnshire has told us: "The Romans, not content with appropriating land all over the world, added to their territory at home by draining lakes and reclaiming marshes." We can instance another great race which, while appropriating land all over the world, has added to it by reclaiming land from water, fresh or salt. The traveller from Great Britain to the most distant of the great British possessions, New Zealand, will find on landing at Wellington a fine street, Lambton Quay, the foreshore of the old beach, seaward of which now rise many of the city's finest buildings on land reclaimed from the sea; and instances of the kind might be indefinitely multiplied. Now the amount of land taken from water by man has been taken more from fresh water than from sea, and, taken in all, the amount is infinitesimal as compared with the total area of land and water; but it has been very considerable in certain small areas of the Earth's surface, and from these small areas have come races of men who have profoundly modified the geography and history of the world. This may be illustrated from the Netherlands and from Great Britain.

Motley, at the beginning of 'The Dutch Republic,' writes of the Netherlands: "A region, outcast of ocean and earth, wrested at last from both domains their richest treasures." Napoleon was credited with saying that the Netherlands were a deposit of the Rhine, and the rightful property of him who controlled the sources; and an old writer pronounced that Holland was the gift of the ocean and of the rivers Rhine and Meuse, as Egypt is of the river Nile. The crowning vision of Goethe's Faust is that of a free people on a free soil, won from the sea and kept for human habitation by the daily effort of man. Such has been the story of the Netherlands. The Netherlands, as a home for civilized men, were, and are, the result of reclamation of dykes and polders. The kingdom has a constantly changing area of between 12,000 and 13,000 square miles. Mr. Marsh, in his book, set down the total amount gained to agriculture at the time he wrote "by dyking out the sea and by draining shallow bays and lakes" at some 1370 square miles, which, he says, was one-tenth of the kingdom; at the same time, he estimated that much more had been lost to the sea—something like 2600 square miles. He writes that there were no important sea dykes before the thirteenth century, and that draining inland lakes did not begin till the fifteenth, when windmills came into use for pumping. In the nineteenth century steam pumps took the place of windmills, science strengthening an already existing process. Between 1815 and 1855, 172 square miles were reclaimed, and this included the lake of Haarlem, some 13 miles long by 6 in breadth, with an area of about 73 square miles. This was reclaimed between 1840 and 1853. At the present time, we are told, about 40 square miles are being reclaimed annually in Holland; and meanwhile the Dutch Government have in

contemplation or in hand a great scheme for draining the Zuyder Zee, which amounts to recovering from the ocean land which was taken by it in historic times at the end of the fourteenth century. The scheme is to be carried out in thirty-three years, and is to cost nearly sixteen million pounds. The reclamation is to be effected by an embankment across the mouth of this inland sea over 18 miles long. The result will be to add 815 square miles of land to the kingdom of the Netherlands, 750 square miles of which will be fertile land, and in addition to create a much-needed freshwater lake with an area of 557 square miles; this lake is to be fed by one of the mouths of the Rhine.

London is partly built on marsh. The part of London where I live, Pimlico, was largely built on piles. A little way north, in the centre of fashion, is Belgrave Square, and here a lady whom I used to know had heard her grandfather say that he had shot snipe. Take the City of London in the strict and narrow sense. The names of Moorfields and Fensbury or Finsbury are familiar to those who know the city. Stow, in his Survey of London, over three hundred years ago, wrote of "The Moorfield which lieth without the postern called Moorgate. This field of old time was called the Moor. This fen or moor field, stretching from the wall of the city betwixt Bishopgate and the postern called Cripplegate to Fensbury and Holywell, continued a waste and unprofitable ground a long time." By 1527, he tells us, it was drained "into the course of Walbrook, and so into the Thames, and by these degrees was this fen or moor at length made main and hard ground which before, being overgrown with flags, sedges, and rushes, served to no use." It is said that this fen or marsh had come into being since Roman times. The reclamation which has been carried out in the case of London is typical of what has been done in numerous other cases. As man has become more civilized, he has come down from his earlier home in the uplands, has drained the valley swamps, and on the firm land thus created has planted the streets and houses of great cities.

The Romans had a hand in the draining of Romney Marsh in Sussex, and here Nature co-operated with man, just as she has co-operated in the deltas of the great rivers, for the present state of the old Cinque Ports, Rye and Winchelsea, shows how much on this section of the English coast the sea has receded. But the largest reclamation was in East Anglia, where the names of the Fens and the Isle of Ely testify to what the surface once was. "For some of our fens," writes Holinshed, "are well known to be either of 10, 12, 16, 20, or 30 miles in length. . . . Wherein also Elie, the famous isle, standeth, which is 7 miles every way, and whereunto there is no access but by three causies." Arthur Young, in 1799, in his 'General View of the Agriculture of the County of Lincoln,' a copy of which he dedicated to that great friend of Australia, Sir Joseph Banks, who was a Lincolnshire landowner and a keen supporter of reclamation, wrote of the draining which had been carried out in Lincolnshire: "The quantity of land thus added to the kingdom has been great; fens of water, mud, wildfowl, frogs, and agues have been converted to rich pasture and arable, worth from 20s. to 40s. an acre; . . . without going back to very remote periods, there cannot have been less than 150,000 acres drained and improved on an average from 5s. an acre to 25s." 150,000 acres is about 234 square miles, but the amount reclaimed by draining in Lincolnshire in the seventeenth, eighteenth, and nineteenth centuries seems to have been well over 500 square miles. The Fenlands as a whole extended into six counties. They were 70 miles in length, from 10 to 30 miles broad, and covered an area of from 800 to 1000 square miles. One estimate I have seen is as high as 1200 square miles. Mr. Prothero, in his book on 'English Farming, Past and Present,' tells us that they were "in the seventeenth century a wilderness of bogs, pools, and reed shoals—a vast morass from which here and there emerged a few islands of solid earth." In

the seventeenth century a Dutch engineer, Vermuyden, was called in to advise, and the result of draining what was called after the peer who contracted for it the Bedford Level, together with subsequent reclamations, was to convert into ploughland and pasture large tracts which, in the words of an old writer, Dugdale, had been "a vast and deep fen, affording little benefit to the realm other than fish or fowl, with overmuch harbour to a rude and almost barbarous sort of lazy and beggarly people." In Lincolnshire there was a district called Holland, and in Norfolk one called Marshland, said to have been drained by, to quote Dugdale again, "those active and industrious people, the Romans."

The Dutch and the English, who thus added to their home lands by reclamation, went far and wide through the world, changing its face as they went. The Dutch, where they planted themselves, planted trees also; and when they came to land like their own Netherlands, again they reclaimed and empoldered. The foreshore of British Guiana, with its canals and sea defences, dating from Dutch times, is now the chief sugar-producing area in the British West Indies. If, again, in Australia man has been a geographical agency, he learnt his trade when he was changing the face of his old home in the British Isles.

Instances of reclaiming land from water might be indefinitely multiplied. We might compare the work done by different nations. In Norway, for instance, Reclus wrote that "the agriculturists are now reclaiming every year 40 square miles of the marshes and fiords." Miss Semple, who, in the 'Influences of Geographical Environment,' writes that "between the Elbe and Scheldt" (that is, including with the Netherlands some of North Germany) "more than 2000 square miles have been reclaimed from river and sea in the past three hundred years," tells us also that "the most gigantic dyke system in the world is that of the Hoangho, by which a territory of the size of England is won from the water for cultivation." Or we might take the different objects which have impelled men here and there to dry up water and bank out sea. Agriculture has not been the only object, nor yet reclaiming for town sites. Thus, in order to work the hematite iron-mines at Hodbarrow, in Cumberland, an area of 170 acres was, in the years 1900–04, reclaimed from the sea by a barrier over 1¼ miles long, designed by the great firm of marine engineers, Coode and Mathews, who built the Colombo breakwater. The reclaimed land, owing to the subsidence caused by the workings, is now much below the level of the sea. Here is an instance of reclamation not adding to agricultural or pastoral area, but giving mineral wealth, thereby attracting population and enriching a district.

How far has land been drowned by the agency of man? Again, the total area is a negligible quantity, but again, relatively to small areas, it has been appreciable, and the indirect effects have been great. The necessities of town life are responsible for new lakes and rivers. Such are the great reservoirs and aqueducts by which water is being brought to New York from the Catskill mountains, a work which a writer in the *Times* has described as "hardly second in magnitude and importance to the Panama canal." In Great Britain cities in search of a water-supply have ordered houses, churches, fields to be drowned, and small lakes to come into existence. Liverpool created Lake Vyrnwy in Montgomeryshire, with a length of nearly 5 miles and an area of 1121 acres. Birmingham is the parent of a similar lake in a wild Radnorshire valley near my old home. The water is not carried for anything like the distance from Mundaring to Kalgoorlie, and on a much greater scale than these little lakes in Wales is the reservoir now being formed in New South Wales by the Burrinjuck dam, on the Murrumbidgee river, which, as I read, is, or will be, 41 miles long, and cover an area of 20 square miles. If I understand right, in this case, by holding up the waters of a river, a long narrow

lake has been or is being called into existence. A still larger volume of water is gathered by the great Assouan dam, which holds up the Nile at the head of the First Cataract, washing, and at times submerging, the old temples on the island of Philæ in mid-stream. First completed in 1902, the dam was enlarged and heightened by 1912; and the result of the dam is at the time of high Nile to create a lake of some 65 square miles in area, as well as to fill up the channel of the river for many miles up-stream. Illustrations of artificial lakes might be multiplied from irrigation works in India. An official report on the State of Hyderabad, written some years ago, has the following reference to the tanks in the granitic country of that State: "There are no natural lakes, but from the earliest times advantage has been taken of the undulating character of the country to dam up some low ground or gorge between two hills, above which the drainage of a large area is collected. Such artificial reservoirs are peculiar to the granitic country, and wherever groups of granite hills occur tanks are sure to be found associated with them." Take again the great ship canals. The Suez canal runs for 100 miles from sea to sea, though for part of its course it runs through water, not through sand. It is constantly growing in depth and width. Its original depth was 26¼ feet; it is now, for nine-tenths of its length, over 36 feet, and the canal is to be further deepened generally to over 39 feet. Its original width at the bottom was 72 feet; it is now, for most of its course, over 147 feet; in other words, the width has been more than doubled. A writer in the *Times* on the wonderful Panama canal said: "The locks and the Gatun dam have entailed a far larger displacement of the earth's surface than has ever been attempted by the hand of man in so limited a space." Outside the locks the depth is 45 feet, and the minimum bottom width 300 feet. The official handbook of the Panama canal says: "It is a lake canal as well as a lock canal, its dominating feature being Gatun lake, a great body of water covering about 164 square miles." The canal is only 50 miles long from open sea to open sea, from shore-line to shore-line only 40. But in making it man, the geographical agency, has blocked the waters of a river, the Chagres, by building up a ridge which connects the two lines of hills between which the river flows, this ridge being a dam 1½ miles long, nearly half a mile wide at its base, and rising to 105 feet above sea-level, with the result that a lake has come into existence which is three-quarters the size of the Lake of Geneva, and extends beyond the limits of the canal zone.

Mr. Marsh, in his book, referred to far more colossal schemes for turning land into water, such as flooding the African Sahara, or cutting a canal from the Mediterranean to the Jordan and thus submerging the basin of the Dead sea, which is below the level of the ocean. The effect of the latter scheme, he estimated, would be to add from 2000 to 3000 square miles to the fluid surface of Syria. All that can be said is that the wild-cat schemes of one century often become the domesticated possibilities of the next and the accomplished facts of the third; that the more discovery of new lands passes out of sight the more men's energies and imagination will be concentrated upon developing and altering what is in their keeping; and that, judging from the past, no unscientific man can safely set any limit whatever to the future achievements of science.

But now, given that the proportion of land to water and water to land has not been, and assuming that it will not be, appreciably altered, has water, for practical purposes, encroached on land, or land on water? In many cases water transport has encroached on land transport. The great isthmus canals are an obvious instance; so are the great Canadian canals. The tonnage passing through the locks of the Sault St. Marie is greater than that which is carried through the Suez canal. Waterways are made where there was dry land, and more often existing inland waterways are converted into sea-going ways. Manchester has become a seaport through its

Ship canal. The Clyde, in Mr. Vernon Harcourt's words, written in 1895, has been "converted from an insignificant stream into a deep navigable river capable of giving access to ocean-going vessels of large draught up to Glasgow." In 1758 the Clyde at low water at Glasgow was only 15 inches deep, and till 1818 no seagoing vessels came up to Glasgow. In 1895 the depth at low water was from 17 to 20 feet, and steamers with a maximum draught of 25½ feet could go up to Glasgow. This was the result of dredging, deepening, and widening the river, and increasing the tidal flow. The record of the Tyne has been similar. The effect of dredging the Tyne was that in 1895—I quote Mr. Harcourt again—"Between Shields and Newcastle, where formerly steamers of only 3 to 4 feet draught used to ground for hours, there is now a depth of 20 feet throughout at the lowest tides." It is because engineers have artificially improved Nature's work on the Clyde and the Tyne that these rivers have become homes of shipbuilding for the whole world. Building training walls on the Seine placed Rouen, 78 miles up the river, high among the seaports of France. The Elbe and the Rhine, the giant rivers Mississippi and St. Lawrence, and many other rivers, have, as we all know, been wonderfully transformed by the hand of the engineer.

But land in turn, in this matter of transport, has encroached upon sea. In old days, when roads were few and bad, when there were no railways, and when ships were small, it was all-important to bring goods by water at all parts as far inland as possible. In England there were numerous flourishing little ports in all the estuaries and up the rivers, which under modern conditions have decayed. No one now thinks of Canterbury and Winchester in connection with seaborne traffic; but Mr. Belloc, in 'The Old Road,' a description of the historical Pilgrims' Way from Winchester to Canterbury, points out how these two old-world cathedral cities took their origin and derived their importance from the fact that each of them, Canterbury in particular, was within easy reach of the coast, where a crossing from France would be made; each on a river—in the case of Canterbury on the Stour just above the end of the tideway. In the days when the Island of Thanet was really an island, separated from the rest of Kent by an arm of the sea, and when the present insignificant river Stour was, in the words of the historian, J. R. Green, "a wide and navigable estuary," Canterbury was a focus to which the merchandise of six Kentish seaports was brought, to pass on inland; it was in effect practically a seaport. Now merchandise, except purely local traffic, comes to a few large ports only, and is carried direct by rail to great distant inland centres. Reclus wrote that bays are constantly losing in comparative importance as the inland ways of rapid communication increase; that, in all countries intersected with railways, indentations in the coast-line have become rather an obstacle than an advantage; and that maritime commerce tends more and more to take for its starting-place ports situated at the end of a peninsula. He argues, in short, that traffic goes on land as far out to sea as possible, instead of being brought by water as far inland as possible. He clearly overstated the case, but my contention is that, for human purposes, the coast-line, though the same on the map, has practically been altered by human agency. Ports have been brought to men as much as men to ports. We see before our eyes the process going on of bridging India to Ceylon so as to carry goods and passengers as far by land as possible, and in Ceylon we see the great natural harbour of Trincomalee practically deserted, and a wonderful artificial harbour created at the centre of population, Colombo.

But let us carry the argument a little further. Great Britain is an island. Unless there is some great convulsion of Nature, to all time the Straits of Dover will separate it from the continent of Europe. Yet we have at this moment a renewal of the scheme for a Channel tunnel, and at this moment men are flying from England to France

and France to England. Suppose the Channel tunnel to be made; suppose flying to be improved—and it is improving every day—what will become of the island? What will become of the sea? They will be there and will be shown on the map, but to all human intents and purposes the geography will be changed. The sea will no longer be a barrier, it will no longer be the only high-road from England to France. There will be going to and fro on or in dry land, and going to and fro neither on land nor on sea. Suppose this science of aviation to make great strides, and heavy loads to be carried in the air, what will become of the ports, and what will become of sea-going peoples? The ports will be there, appearing as now on the map, but Birmingham goods will be shipped at Birmingham for foreign parts, and Lithgow will export mineral direct, saying good-bye to the Blue mountains and even to Sydney harbour.

Now, in saying this I may well be told by my scientific colleagues that it is all very well as a pretty piece of fooling, but that it is not business. I say it as an unscientific man with a profound belief in the limitless possibilities of science. How long is it since it was an axiom that, as a lump of iron sinks in water, a ship made of iron could not possibly float? Is it fatuous to contemplate that the conquest of the air, which is now beginning, will make it a highway for commercial purposes? We have aeroplanes already which settle on the water and rise again; we are following on the track of the gulls which we wonder at far away in the limitless waste of ocean. A century and a half ago the great Edmund Burke ridiculed the idea of representatives of the old North American colonies sitting in the Imperial Parliament; he spoke of any such scheme as fighting with Nature and conquering the order of Providence; he took the distance, the time which would be involved—six weeks from the present United States to London. If anyone had told him that what is happening now through the applied forces of science might happen, he would have called him a madman. Men think in years, or at most in lifetimes; they ought sometimes to think in centuries. I believe in Reclus's words, "All man has hitherto done is a trifle in comparison with what he will be able to effect in future." Science is like a woman. She says no again and again, but means Yes in the end.

In dealing with land and water I have touched upon natural divisions and natural boundaries, which are one of the provinces of geography. Flying gives the go-by to all natural divisions and boundaries, even the sea; but let us come down to the earth. Isthmuses are natural divisions between seas; the ship canals cut them and link the seas—the canal through the Isthmus of Corinth, the canal which cuts the Isthmus of Perekop between the Crimea and the mainland of Russia, the Baltic canal, the Suez canal, the Panama canal. The Suez canal, it will be noted, though not such a wonderful feat as the Panama canal, is more important from a geographical point of view, in that an open cut has been made from sea to sea without necessity for locks, which surmount the land barrier but more or less leave it standing. Inland, what are natural divisions? Mountains, forests, deserts, and, to some extent, rivers. Take mountains. "High, massive mountain systems," writes Miss Semple, "present the most effective barriers which man meets on the land surface of the earth." But are the Rocky mountains, for instance, boundaries, dividing-lines, to anything like the extent that they were now that railways go through and over them, carrying hundreds of human beings back and fore day by day? On what terms did British Columbia join the Dominion of Canada? That the natural barrier between them should be pierced by the railway. Take the Alps. The canton Ticino, running down to Lake Maggiore, is politically in Switzerland; it is wholly on the southern side of the Alps. Is not the position entirely changed by the St. Gothard tunnel, running from Swiss territory into Swiss territory on either side of the mountains?

If, in the Bible language, it requires faith to remove mountains, it is not wholly so with other natural boundaries. Forests were, in old days, very real natural dividing-lines. They were so in England, as in our own day they have been in Central Africa. Between forty and fifty years ago, in his 'Historical Maps of England,' Prof. C. H. Pearson, whose name is well known and honoured in Australia, laid down that England was settled from east and west, because over against Gaul were heavy woods, greater barriers than the sea. Kent was cut off from Central England by the Andred Weald, said to have been, in King Alfred's time, 120 miles long and 30 broad. Here are Prof. Pearson's words: "The axe of the woodman clearing away the forests, the labour of nameless generations reclaiming the fringes of the fens or making their islands habitable, have gradually transformed England into one country, inhabited by one people. But the early influences of the woods and fens are to isolate and divide." Thus the cutting down of trees is sometimes a good, not an evil, and there are some natural boundaries which man can wholly obliterate.

Can the same be said of deserts? They can certainly be pierced, like isthmuses and like mountains. The Australian desert is a natural division between Western and South Australia. The desert will be there, at any rate, for many a long day after the transcontinental railway has been finished, but will it be, in anything like the same sense as before, a barrier placed by Nature and respected by man? Nor do railways end with simply giving continuous communication, except when they are in tunnels. As we all know, if population is available, they bring in their train development of the land through which they pass. Are these deserts of the earth always going to remain "deserts idle"? Is man going to obliterate them? In the days to come, will the desert rejoice and blossom as the rose? What will dry farming and what will afforestation have to say? In the evidence taken in Australia by the Dominions Royal Commission, the Commissioner for Irrigation in New South Wales tells us that "the dry farming areas are carried out westward into what are regarded as arid lands every year," and that, in his opinion, "we are merely on the fringe of dry farming" in Australia. A book has lately been published entitled 'The Conquest of the Desert.' The writer, Dr. Macdonald, deals with the Kalahari desert in South Africa, which he knows well, and for the conquest of the desert he lays down that three things are essential—population, conservation, and afforestation. He points out in words which might have been embodied in Mr. Marsh's book, how the desert zone has advanced through the reckless cutting of trees, and how it can be flung back again by tree barriers to the sand-dunes. By conservation he means the system of dry farming so successful in the United States of America, which preserves the moisture in the soil and makes the desert produce fine crops of durum wheat without a drop of rain falling upon it from seedtime to harvest, and he addresses his book "to the million settlers of to-morrow upon the dry and desert lands of South Africa." If the settlers come, he holds that the agency of man, tree-planting, ploughing and harrowing the soil, will drive back and kill out the desert. The effect of tree-planting in arresting the sand-dunes and reclaiming desert has been very marked in the Landes of Gascony. Here, I gather from Mr. Perkins' report, are some 3600 square miles of sandy waste, more than half of which had, as far back as 1882, been converted into forest land, planted mainly with maritime pines.

What, again, will irrigation have to say to the deserts? Irrigation, whether from underground or from overground waters, has already changed the face of the earth, and as the years go on, as knowledge grows and wisdom, must inevitably change it more and more. I read of underground waters in the Kalahari. I read of them too in the Libyan desert. In the *Geographical Journal* for 1902 it is

stated that at that date nearly 22,000 square miles in the Algerian Sahara had been reclaimed with water from artesian wells. What artesian and sub-artesian water has done for Australia you all know. If it is not so much available for agricultural purposes, it has enabled flocks and herds to live and thrive in what would be otherwise arid areas. Prof. Gregory, Mr. Gibbons Cox, and others have written on this subject with expert knowledge; evidence has been collected and published by the Dominions Royal Commission, but I must leave to more learned and more controversial men than I am to discuss whether the supplies are plutonic or meteoric, and how far in this matter you are living on your capital.

If we turn to irrigation from overground waters, I hesitate to take illustrations rom Australia, because my theme is the blotting out of the desert, and most of the Australian lands which are being irrigated from rivers, and made scenes of closer settlement, would be libelled if classed as desert. Mr. Elwood Mead told the Royal Commission that the State irrigation works in Victoria, already completed or in process of construction, can irrigate over 600 square miles, and that, if the whole water supply of the State were utilised, more like 6000 square miles might be irrigated. The Burrinjuck scheme in New South Wales will irrigate in the first instance not far short of 500 square miles, but may eventually be made available for six times that area. If we turn to irrigation works in India, it appears from the second edition of Mr. Buckley's work on the subject, published in 1905, that one canal system alone, that of the Chenab in the Punjab, had, to quote his words, turned "some two million acres of wilderness (over 3000 square miles) into sheets of luxuriant crops." "Before the construction of the canal," he writes, "it was almost entirely waste, with an extremely small population, which was almost nomad. Some portion of the country was wooded with jungle trees, some was covered with small scrub camel thorn, and large tracts were absolutely bare, producing only on occasions a brilliant mirage of unbounded sheets of fictitious water." The Chenab irrigation works have provided for more than a million of human beings: and, taking the whole of India, the Irrigation Commission of 1901–3 estimated that the amount of irrigated land at that date was 68,750 square miles; in other words, a considerably larger area than England and Wales. Sir William Willcocks is now reclaiming the delta of the Euphrates and Tigris. The area is given as nearly 19,000 square miles, and it is described as about two-thirds desert and one-third freshwater swamp. Over 4000 square miles of the Gezireh plain, between the Blue and the White Nile, are about to be reclaimed, mainly for cotton cultivation, by constructing a dam on the Blue Nile at Sennaar, and cutting a canal 100 miles long which, if I understand right, will join the White Nile 30 miles south of Khartum.

With the advance of science, with the growing pressure of population on the surface of the Earth, forcing on reclamation as a necessity for life, is it too much to contemplate that human agency in the coming time will largely obliterate the deserts which now appear on our maps? It is for the young peoples of the British Empire to take a lead in—to quote a phrase from Lord Durham's great report—"the war with the wilderness," and the great feat of carrying water for 350 miles to Kalgoorlie, in the very heart of the wilderness, shows that Australians are second to none in the ranks of this war.

It is a commonplace that rivers do not make good boundaries because they are easy to cross by boat or bridge. Pascal says of them that they are "des chemins qui marchent" (roads that move), and we have seen how these roads have been and are being improved by man. "Rivers unite," says Miss Semple; and again, "Rivers may serve as political lines of demarcation, and therefore fix political frontiers, but they can never take the place of natural boundaries." All the same,

in old times at any rate, rivers were very appreciable dividing-lines, and when you get back to something like barbarism, that is to say in time of war, it is realized how powerful a barrier is a river. Taking, then, rivers as in some sort natural boundaries, or treating them only as political boundaries, the point which I wish to emphasize is that they are becoming boundaries which, with modern scientific appliances, may be shifted at the will of man. In the days to come the diversion of rivers may become the diversion of a new race of despotic rulers with infinitely greater power to carry out their will or their whim than the Pharaohs possessed when they built the Pyramids. You in Australia know how thorny a question is that of the control of the Murray and its tributaries. There are Waterways Conventions between Canada and the United States. Security for the headwaters of the Nile was, and is, a prime necessity for the Sudan and Egypt. The Euphrates is being turned from one channel into another. What infinite possibilities of political and geographical complications does man's growing control over the flow of rivers present!

Thus I have given you four kinds of barriers or divisions set by Nature upon the face of the Earth—mountains, forests, deserts, rivers. The first, the mountains, man cannot remove, but he can and does go through them to save the trouble and difficulty of going over them. The second, the forests, he has largely cleared away altogether. The third, the deserts, he is beginning to treat like the forests. The fourth, the rivers, he is beginning to shift when it suits his purpose and to regulate their flow at will.

I turn to climate. Climates are hot or cold, wet or dry, healthy or unhealthy. Here our old friends the trees have much to say. Climates beyond dispute become at once hotter and colder when trees have been cut down and the face of the earth has been laid bare; they become drier or moister according as trees are destroyed or trees are planted and hold the moisture; the cutting and planting of timber affects either one way or other the health of a district. The tilling of the soil modifies the climate. This has been the case, according to general opinion, in the north-west of Canada, though I have not been able to secure any official statistics on the subject. In winter-time broken or ploughed land does not hold the snow and ice to the same extent as the unbroken surface of the prairie; on the other hand, it is more retentive at once of moisture and of the rays of the sun. The result is that the wheat zone has moved further north, and that the intervention of man has, at any rate for agricultural purposes, made the climate of the great Canadian North-West perceptibly more favourable than it was. In Lord Strathcona's view, there was some change even before the settlers came in, as soon as the rails and telegraph lines of the Canadian Pacific Railway were laid. He told me that in carrying the line across a desert belt it was found that, within measurable distance of the rail and telegraph line, there was a distinct increase of dew and moisture. I must leave it to men of science to say whether this was the result of some electrical or other force, or whether what was observed was due simply to a wet cycle coinciding with the laying of the rails and the erection of the wires. I am told that it is probably a coincidence of this kind which accounts for the fact that in the neighbourhood of the Assouan dam there is at present a small annual rainfall, whereas in past years the locality was rainless. Reference has already been made to the effect of cultivation in the Kalahari desert in increasing the storage of moisture in the soil. But it is when we come to the division between healthy and unhealthy climates that the effect of science upon climate is most clearly seen. The great researches of Ross, Manson, and many other men of science, British and foreign alike, who have traced malaria and yellow fever back to the mosquito, and assured the prevention and gradual extirpation of tropical

diseases, bid fair to revolutionize climatic control. Note, however, that in our penitent desire to preserve the wild fauna of the Earth we are also establishing preserves for mosquitoes, trypanosomes, and the tsetse fly.

Nowhere have the triumphs of medical science been more conspicuous than where engineers have performed their greatest feats. De Lesseps decided that Ismailia should be the headquarters of the Suez canal, but the prevalence of malaria made it necessary to transfer the headquarters to Port Said. In 1886 there were 2300 cases of malaria at Ismailia; in 1900 almost exactly the same number. In 1901 Sir Ronald Ross was called in to advise; in 1906 there were no fresh cases, and malaria has been stamped out. Lesseps' attempt to construct the Panama canal was defeated largely, if not mainly, by the frightful death-rate among the labourers; 50,000 lives are said to have been lost, the result of malaria and yellow fever. When the Americans took up the enterprise they started with sending in doctors and sanitary experts, and the result of splendid medical skill and sanitary administration was that malaria and yellow fever were practically killed out. The Panama canal is a glorious creation of medical as well as of engineering science, and this change of climate has been mainly due to reclamation of pools and swamps, and to cutting down bush, for even the virtuous trees, under some conditions, conduce to malaria. Man is a geographical agency, and in no respect more than in the effect of his handiwork on climate, for climate determines products, human and others. Science is deciding that animal pests shall be extirpated in the tropics, and that there shall be no climates which shall be barred to white men on the ground of danger of infection from tropical diseases.

If we turn to products, it is almost superfluous to give illustrations of the changes wrought by man. As the incoming white man has in many places supplanted the coloured aboriginal, so the plants and the living creatures brought in by the white man have in many cases, as you know well, ousted the flora and fauna of the soil. Here is one well-known illustration of the immigration of plants. Charles Darwin, on the voyage of the *Beagle*, visited the island of St. Helena in the year 1836. He wrote "that the number of plants now found on the island is 746, and that out of these fifty-two alone are indigenous species." The immigrants, he said, had been imported mainly from England, but some from Australia, and, he continued, "the many imported species must have destroyed some of the native kinds, and it is only on the highest and steepest ridges that the indigenous flora is now predominant.

Set yourselves to write a geography of Australia as Australia was when first made known to Europe, and compare it with a geography now. Suppose Australia to have been fully discovered when Europeans first reached it, but consider the surface then and the surface now, and the living things upon the surface then and now. Will not man have been found to be a geographical agency? How much waste land, how many fringes of desert have been reclaimed? The wilderness has become pasture land, and pasture land, in turn, is being converted into arable. The Blue mountains, which barred the way to the interior, are now a health resort. Let us see what Sir Joseph Banks wrote after his visit to Australia on Captain Cook's first voyage in 1770. He has a chapter headed "Some Account of that part of New Holland now called New South Wales." New Holland he thought "in every respect the most barren country I have seen; . . . the fertile soil bears no kind of proportion to that which seems by Nature doomed to everlasting barrenness. . . . In the whole length of coast which we sailed along there was a very unusual sameness to be observed in the face of the country. Barren it may justly be called, and in a very high degree, so far, at least, as we saw." It is true that he only saw the land by the sea, but it was the richer eastern side of Australia, the outer edge of New South Wales

and Queensland. What animals did he find in Australia? He "saw an animal as large as a greyhound, of a mouse colour, and very swift. . . He was not only like a greyhound in size and running, but had a tail as long as any greyhound's. What to liken him to I could not tell." Banks had a greyhound with him, which chased this animal. "We observed, much to our surprise, that instead of going upon all fours, this animal went only on two legs, making vast bounds." He found out that the natives called it kangooroo, and it was "as large as a middling lamb." He found "this immense tract of land," which he said was considerably larger than all Europe, "thinly inhabited, even to admiration, at least that part of it that we saw." He noted the Indians, as he called them, whom he thought "a very pusillanimous people." They "seemed to have no idea of traffic"; they had "a wooden weapon made like a short scimitar." Suppose a new Sir Joseph Banks came down from the planet Mars to visit Australia at this moment, what account would he give of it in a geographical handbook for the children of Mars? He would modify the views about barrenness, if he saw the cornfields and flocks and herds; if he visited Adelaide, he would change his opinion as to scanty population, though not so, perhaps, if he went to the back blocks. He would record that the population was almost entirely white, apparently akin to a certain race in the North sea, from which, by tradition, they had come; that their worst enemies could not call them pusillanimous; that they had some ideas of traffic, and used other weapons than a wooden scimitar; and he would probably give the first place in animal life, not to the animal like a greyhound on two legs, but to the middling lamb, or perhaps to the ubiquitous rabbit. Australia is the same island continent that it always was; there are the same indentations of coast, the same mountains and rivers, but the face of the land is different. In past years there was no town, and the country was wilderness; on the surface of the wilderness many of the living things were different; and from under the earth have come water and mineral, the existence of which was not suspected. A century hence it will be different again, and I want to see sets of maps illustrating more clearly than is now the case the changes which successive generations of men have made and are making in the face of Australia and of the whole earth.

More than half a century ago Buckle, in his 'History of Civilisation,' wrote: "Formerly the richest countries were those in which Nature was most bountiful; now the richest countries are those in which man is most active. For in our age of the world, if Nature is parsimonious we know how to compensate her deficiencies. If a river is difficult to navigate, or the country difficult to traverse, an engineer can correct the error and remedy the evil. If we have no rivers we make canals; if we have no natural harbours we make artificial ones." These words have a double force at the present day and in the present surroundings, for nowhere has man been more active as a geographical agency than in Australia; and not inside Australia only, but also in regard to the relations of Australia to the outside world.

An island continent Australia is still, and always will be, on the maps. It always will be the same number of miles distant from other lands; but will these maps represent practical everyday facts? What do miles mean when it takes a perpetually diminishing time to cover them? Is it not truer to facts to measure distances, as do Swiss guides, in Stunden (hours)? What, once more, will an island continent mean if the sea is to be overlooked and overflown? The tendency is for the world to become one; and we know perfectly well that, as far as distance is concerned, for practical purposes the geographical position of Australia has changed through the agency of scientific man. If you come to think of it, what geography has been more concerned with than anything else, directly or indirectly, is distance. It is the knowledge of other places not at our actual door that we teach in geography, how

to get there, what to find when we get there, and so forth. The greatest revolution that is being worked in human life is the elimination of distance, and this elimination is going on apace. It is entering into every phase of public and private life, and is changing it more and more. The most difficult and dangerous of all Imperial problems at this moment is the colour problem, and this has been entirely created by human agency, scientific agency, bringing the lands of the coloured and the white men closer together. Year after year, because distance is being diminished, coming and going of men and of products is multiplying; steadily and surely the world is becoming one continent. This is what I want geographers to note and the peoples to learn. Geographers have recorded what the world is according to Nature. I want them to note and teach others to note how under an all-wise Providence it is being subdued, replenished, recast, and contracted by man.

REVIEWS.

EUROPE.

The Baltic Provinces of Russia.

'Baltische Landeskunde.' By K. R. Kupffer and others. Riga: G. Löffler, 1911. Pp. xvi., 557. *With* 64 *Figures, and an Atlas containing* 28 *Plates and* 6 *Maps. Price M.*14.50.

This lengthy treatise upon the Baltic provinces of Russia includes sections by various authors upon the physical geography, geology, climatology, flora and fauna, archæology, historical and political geography of Estland, Livland, and Kurland. Unfortunately there is no special section dealing with economic geography and communications, an omission which detracts much from the value of the work as a regional handbook. A large part of the volume is devoted to the geology of the region, and this is prefaced by a general account of processes and principles. The accompanying atlas contains orographical and other maps illustrating each section of the book, together with photographs of typical scenery.

The most interesting and useful section of the book is undoubtedly that dealing with the physical geography of the region. The ground rock rarely forms any prominent surface features owing to the fact that the ancient peneplain was completely buried under glacial accumulations at the close of the ice age. The relief is well shown on the orographical map, and the present topography is due in part to the irregular deposition of the morainic material and in part to subsequent erosion by the rivers, some of which, *e.g.* the Düna, the Windau, and the Livland Aa, have cut great gorges into the marginal highlands. A striking feature on the map is the great bow-shaped terminal moraine on the borders of Kurland and Lithuania, breached by the headstream of the Kurland Aa. The plains of Pernau and Mitau, with the narrow coastal platform and islands of Oesel and Dagö, are due to a recent regional elevation which almost succeeded in transforming the Gulf of Riga into an inland sea. Lake Peipus is the remnant of a larger lake which formerly extended southward almost to Dünaburg, the southern portion of which was ultimately drained to the Gulf of Riga on the cutting of the Düna gorge between the South Livland and the Upper Kurland highlands. The rivers of the region are well described in a separate section (p. 45). The Düna has not yet been regulated for navigation, and is at present navigable for a distance of only 25 kilometres from its mouth,

its channel being much obstructed by rapids for a considerable distance above Dahlen. Riga, 16 kilometres upstream, surrounded by swamp and forest, is the port for the grain-growing district of Mitau as well as the outlet of the lumber industry of the Livonian forests. The glint coast of the Gulf of Finland and the dunes and lagoons of the western shore are described in detail, and a chapter is devoted to the hydrography of the neighbouring portion of the Baltic Sea. A copious bibliography is appended to each section.

ASIA.

Chinese Annals.

'Annals and Memoirs of the Court of Peking. From the 16th to the 20th Century.' By E. Backhouse and J. O. P. Bland. London: Heinemann. 1914. Pp. x., 531. *Illustrations.* 16*s. net.*

The present work covers a far larger space of time than the author's previous book 'China under the Empress Dowager,' but, like it, the circumstantial character of the incidents and annals, the clearness of the narration and apparent authenticity and realism of the facts lend an interest to the stories which a mere ordinary compilation could scarcely hope to attain. Half of the book is devoted to annals of the Ming, and the other half to the Manchu dynasty. There is naturally but little geography, the memoirs being mainly historical and often gruesome. At the same time such chapters "A Chinese Haroun el Raschid," the decline of the Mings, and "The Memoirs of the Boxer Year" are specially interesting. The authors are evidently no believers in the Republican form of Government for China. They declare that those who believe in its practical utility advocate something which undermines the ethical basis of China's whole social system. In China they remark, quoting one of the native sages, "Law is not a rule imposed from above, it is the formula of the national life, and its embodiment in practice precedes its inscription on a code. Hence it is that in China government is neither arbitrary nor indispensable. Destroy our authorities, central and provincial, and our life will proceed very much as before. Come what may, the family remains with all that it involves, the attitude of mind remains, the spirit of order, industry and thrift. It is these that make up China."

'Terry's Japanese Empire.' A Guide-book for Travellers. By Philip Terry, F.R.G.S. (London: Constable. 1914. *Maps and Plans.* 21*s. net.*) This is undoubtedly the most complete guide-book to Japan we have yet seen, for, in addition to no fewer than 800 pages filled with the average information usually pertaining to guide-books, there are 283 pages of a preliminary character containing special monographs, such as Travelling Expenses, Money, Guides, Hints to Travellers, Shops and Curios, the People and their Homes, Arts, Customs, Religion, and History, all of which information is likely to prove of the highest utility to intending tourists. There are also serviceable sections on the Japanese language, Japanese vocabularies, Japanese phrases, numerals, and expressions of frequent occurrence in everyday conversation. Terry's guide-books have already achieved a deserved reputation, and this, the latest exemplar, fully sustains their character for all-round usefulness.

AFRICA.

The Great Rift Valley in Northern German East Africa.

'Das Hochland der Riesenkrater und die umliegenden Hochländer Deutsch-Ostafrikas.' Von Dr. Fritz Jaeger. (Mitt. aus den Deutschen Schutzgebieten, Ergänzungshefte Nr. 4 und 8.) Berlin: Mittler und Sohn. 1911–13. *Price M.*7.20.

Between the south-eastern shore of the Victoria Nyanza and the volcanoes of Kilima-Njaro and Meru is an area which was little known until the expedition in 1906–7 of Dr. Fritz Jaeger, now Professor of Colonial Geography in the University of Berlin. A detailed account of the results of his journey has been issued in two parts of the 'Mitteilungen aus den Deutschen Schutzgebieten' (No. 4, 1911, 133 pp., 3 plates and 3 maps; and No. 8, 1913, 213 pp., 12 plates and 3 maps). This work shows most detailed and careful observation, and forms a valuable contribution to the geography of this part of Eastern Africa. The maps are clear and most instructive and the text is illustrated by a series of excellent photographs by the author's companion, Ed. Oehler. The first part describes the route of the expedition, and includes the cartographic data, a carefully identified list by L. Finckh of the rock specimens collected, catalogues of the zoological and botanical collections, analyses of soils, encrustations, and water-samples, interesting descriptions of native dances and music, and other ethnographic observations. A report by B. Struck on the languages of the people of Tatoga and Iraku is illustrated by a map of racial distribution in Eastern Equatorial Africa, which shows clearly how far the Hamites have forced their way southward, leaving the former Bantu inhabitants crowded to the valleys and the coasts, or left in occasional ethnographic islands.

The second monograph describes in detail the geography of the area investigated. Geologically it consists of a vast foundation of Archean rocks, mainly gneisses, schists, and various granitic rocks. The older Archean rocks are covered by sediments, among which the author recognizes an extension of the Witwatersrand beds, and some sandstones which he correlates with the Cape formation; these old rocks are covered to the east by a wide volcanic belt, which extends from Kilima-Njaro through Mount Meru westward to the volcanic highlands of the Riesenkrater. The volcanic rocks, according to the determinations by Finckh, include nephelinites, alkali-trachytes, limburgites, basanites, trachy-dolerites, nepheline-tephrites and basalts, so that they agree in character with those of the adjacent volcanic area of British East Africa.

The author's work shows that the major topography of the country is due to great subsidences. He describes the Pangani basin as a sunkland, other sunklands in the Masai steppes, and lines of fractures roughly concentric to the south-eastern shore of Victoria Nyanza. The main movements are those belonging to the Great Rift Valley, and the most interesting geographical problem in this area is the change in the nature of that valley as it passes into the German territory. The western wall continues southward past Lake Magadi and forms also the western scarp of Lake Manyara, for which the author adopts the name of Lawa-ya-Mweri. The eastern wall, however, disappears a little south of Lake Magadi. "The east wall of the Great Rift Valley," says the author (pt. 8, p. 163), "is in our district far from sharply defined, indeed, scarcely present." It disappears in the volcanic belt between the Riesenkrater and Mount Meru; but it may be represented by the great fractures past Mount Ufioma to the south of Lake Manyara. The western wall, on the other hand, remains a striking topographic feature; and to the west of this wall is a horst, which is broken through by a series of rift valleys; their faults have throws of from 600 to over

2500 feet, and they branch off from the western wall of the Great Rift Valley and pass away from it until they trend south-westward; the largest, the Wembere-Nyarasa rift valley, bends round again to a meridional course in the southern part of the area. This valley includes the salt-lake of Nyarasa (or Eyassi). Parallel to it, to the south-east, is a narrower rift valley named by the author the Hohenlohe rift valley. Still further to the south-east is the sunkland of Tungobesh; its floor is covered with volcanic tuffs and contains sixteen craters, many of which contain lakes; the author describes some of these lakes as "Maare," and he regards their basins as due to volcanic explosions.

The final chapter describes the general geography of the basins without outlets, and the author refers to the lake terraces around Lake Suess in British East Africa, and around the lakes on the German side of the frontier as evidence of a former wetter period. He also discusses the origin of the isolated rocky hills known as "Inselberge," which he attributes to the effects of denudation and to the widening of valleys cutting away sheets of similar rocks; he rejects the hypothesis that they are intrusive masses which have been left as hills by the removal of surrounding softer rocks.

The work is accompanied by several valuable maps, including one of the area around the Nyarasa rift valley and extending eastward to Lake Manyara on the scale of 1 to 300,000, one of the Riesenkrater highlands on the scale of 1 to 150,000, and geological and botanical maps on the scale of 1 to 1,000,000.

J. W. G.

Mount Elgon and Eastern Uganda.

'Quer Durch Uganda: Eine Forschungreise in Zentral-Afrika, 1911–12.' By Rudolf Kmunke. Berlin: Dietrich Reimer (Ernst Vohsen). 1913.

The work under review is as beautifully produced as are most of the publications of the house of Dietrich Reimer. It is a credit to German typography, as it is to their art of photograph reproduction. The coloured plates, most if not all of them actual colour photographs, are not perhaps as strikingly good or vivid in tint as some others in contemporary works on Africa, but they are free from falsity, and give a more vivid impression of the strange Alpine vegetation of Equatorial Africa than mere black and white could do. The photographs of negro and negroid types of the eastern portion of the Uganda Protectorate will alone give the work a position of importance in ethnographical literature. They are the means of revealing to us (if we were not previously aware of their existence) tribes of Nilotic negroes whose bodily conformation amongst the men is singularly handsome and statuesque, though the beauty perhaps stops short of the facial lineaments. As examples to justify this assertion I would refer to the picture opposite p. 104, young Tobur men, and the young Chief of Nagua, between pp. 80 and 81. The companion study of a Karamojo guide alongside this last shows the average "Bantu" type of negro as contrasted with the more negroid Nilote. Although the Karamojo now speak a Nilotic language, they seem from several points of view to have been originally a Bantu people—a theory first put forth by Oskar Neumann.

In the autumn of 1911, Herr Kmunke (accompanied by Dr. Robert Stiegler) left Europe for East Africa and made his way through the now hackneyed regions of British East Africa to Entebbe and Mengo, the European and native capitals of the kingdom of Buganda. Here he made the acquaintance of Sir Frederick Jackson (whose Christian name, by-the-by, he misrenders). Sir Frederick Jackson gave him all the requisite facilities and assistance for the

scientific investigation of the Uganda Protectorate. From Entebbe, therefore, this Austrian expedition directed itself through Busoga to the slopes of the great Elgon volcano, which it was Herr Kmunke's special desire to explore.

Considering its striking appearance and its particularly interesting fauna, flora, and human inhabitants, it is remarkable that we should have had to wait as long as nearly twenty years for a renewal of the exploration of the highest points of the rim of Elgon's crater commenced in 1890 by Sir Frederick Jackson and Mr. Ernest Gedge. These travellers reached a point which they estimated at 14,044 feet, judging the highest peak (to which, however, they apparently gave no name) to be not more than 50 feet higher. The Kmunke expedition ascended various prominences on the rim of the crater and determined their altitudes. To one of these peaks they very rightly gave the name of Jackson, and calculated it to be 4311 metres in altitude (14,144 feet). To another columnar mass they gave the name of Kaiser-Franz-Josef, reckoning its altitude as 4382 metres (14,377 feet). Kaiser-Franz-Josef peak is on the extreme north of the rim of this vast crater (about 10 miles across at its widest), and Jackson peak on the extreme south. But to the east of Kaiser-Franz-Josef peak is marked on Kmunke's map an even higher prominence, calculated at 4445 metres (14,584 feet), and this point (which may turn out to be the highest peak of Elgon) remains unnamed.

The data given are not sufficient to enable us to determine authoritatively to what extent Herr Kmunke's expedition has really covered new ground and supplemented the original report of the Jackson-Gedge expedition. Some dissatisfaction has also been evinced in that the Austrian explorer should have given to a point in British territory the name of his venerated ruler. Apparently before doing so he wrote to Sir Frederick Jackson and secured his assent in a telegram. If the matter is to be argued out to a fine point of etiquette, it would, perhaps, have been better if the question had been referred not only to Sir Frederick Jackson and Mr. Gedge as the first explorers of Elgon, but also to the British Secretary of State for the Colonies. However, if, as seems to be surmised by Herr Kmunke, there remains yet a higher peak to be scaled, our own sovereign may some day share honours with the Austrian emperor. Of course, in the ordinary way it is becoming most distasteful to geographers that the names of foreign personages should be applied to prominent geographical features in newly explored countries in lieu of widely accepted native names. But it would be difficult to find, either on Ruwenzori or on Elgon, indisputable and distinct native appellations of the more prominent points of the Alpine region so rarely visited by them. In all such instances no more correct procedure could be followed than that of the Duke of the Abruzzi.

From Elgon, Kmunke's expedition pursued a very interesting route through little-known country across Lake Salisbury (otherwise Lake Kumi), through the Teso country and the mountains of Nakwa and Tobur to the Acholi country and the Nile at Nimule, whence the expedition returned to Europe *viâ* Khartum. Meteorological observations were taken and collections of birds and objects of ethnological interest were made. Altogether the work is one of great interest, especially to the ethnologist, and it stands out in pleasant contrast to some other recently published books on Africa, in that it gives full credit for their work to previous explorers.

H. H. JOHNSTON.

House Demons and Demon-Dancing.

'The Ban of the Bori.' By Major A. J. N. Tremearne. London: Heath, Cranton & Ouseley. 1914. Pp. 497. *Illustrations.* 21*s. net.*

The *bori* of which Major Tremearne writes in his latest contribution to knowledge of Hausa beliefs and customs are, in the first place, the familiar spirits supposed to be associated with the life of each individual, and, in the second place, the forces of the spirit world in general. These *bori* are mostly evil spirits, responsible for the various illnesses suffered by mankind and requiring to be propitiated by offerings and sacrifices, by the setting apart of certain rooms as temples for their use, and by being honoured with dances, or rites, during which certain of the worshippers become temporarily possessed by the spirits. In 'The Ban of the Bori' Major Tremearne shows how completely the lives of the Hausas, from birth to death, are under the dominance of their beliefs in these spirits, or demons. The different classes of demons are discussed in detail in the latter half of the book; previously Major Tremearne passes under review the family relationships and every-day pursuits of the Hausa communities with which he is dealing, with special reference to the influence of magical beliefs. He covers a wide field, but as he says, "In its broadest sense this branch of anthropology is as much concerned with the price of matches (for a fire-spirit is a necessity in their absence) as with the dimensions of a skull, the shape of which depends to some extent upon the activities of the demons, for it must be massaged."

In former books Major Tremearne has recorded and discussed data collected by him among the Hausas of Nigeria. In this book he gives the fruits of investigations among the Hausa colonies in Tunis and Tripoli, countries in which he spent four months in the first half of last year. Originally slaves, these Hausas are a class apart from the Arabs, on whom they are still largely dependent. Their beliefs have been modified by contact with the Arabs, and Major Tremearne has found it very difficult to distinguish the West African elements from those due to local influences. In Tunis and Tripoli he learned of many *bori* of which he had not heard in West Africa, but he thinks it almost certain that most of them are known to the Nigerian Hausas. The book has been revised in proof during a second visit to North Africa this year, and though it has not been possible to insert the new material collected, Major Tremearne hopes to embody it in a later volume. Meanwhile, there is much in the present work to interest both the student of the geographical distribution of religions and the general reader.

Tropical Administration.

'Administration in Tropical Africa.' By Captain C. H. Stigand. London: Constable & Co. 1914. Pp. viii., 302. 10*s.* 6*d. net.*

Captain Stigand is known as an African traveller and sportsman, with leanings towards the study of native history and languages. In his latest book he appears as the practical administrator. There are indications, as in one of his former books, of the tendency to theorize which comes to the thoughtful man living much alone, but the book does really grapple with the every-day problems which confront the young administrator in tropical Africa, and offers much sound information and advice as to how to deal with them. Its merits in this respect are sufficiently proved by the high praise accorded to it in a Foreword by Sir Reginald Wingate. He expresses confidence that it "will be of practical use and assistance to those whose inclinations lead them to devote their lives to the task of bringing

the benefits of good government and civilization to our subject tribes in the more distant parts of the Empire." The beginnings of an administration, law and equity, native reserves, industry and agriculture, accounts and office work, transport, labour, station buildings and other improvements, forestry, punitive expeditions—these are some of the topics which Captain Stigand discusses. Though based on his experience in tropical Africa, the usefulness of the book is not confined to the African administrator. It may be read with advantage by any one going out for the first time to take up administrative work in a tropical dependency, while men experienced in that class of service can compare their views with those expressed by Captain Stigand on the many intricate questions which arise for consideration.

AMERICA.

Early English Colonization in America.

'The Colonizing Activities of the English Puritans. The Last Phase of the Elizabethan Struggle with Spain.' By Arthur Percival Newton, with an Introduction by Charles M. Andrews. Yale Historical Publications Miscellany, I. New Haven, London, Oxford: 1914. 10*s.* 6*d.*

Mr. Newton has written a valuable and interesting book. He has filled a gap in West Indian history by giving us the full story of the bold attempt to colonize Providence Island. He has broadened our view of the colonizing activities of the English Puritans by placing this story in its relation to the colonization of New England, and he has illustrated the continuity of our colonial policy from the piratical exploits of Elizabethan days down to the "western design" of Cromwell. The Puritan leaders in England did not see altogether eye to eye with their religious brethren in New England, and turned their energies to the founding of a colony in the Caribbean sea, from which grew also a more ambitious project of English colonization on the mainland of Central America. New England succeeded, and Providence Island and the larger project it gave birth to failed. To New England, Englishmen could carry their old order of life; in the West Indies, apart from the political difficulties that had to be faced, climatic and economic conditions were unfamiliar and unfavourable to ideal experiments. Thus, in the competition between the two regions for the capital and labour that went out of England in the early seventeenth century, New England proved the stronger. Mr. Newton gives us a valuable chapter in the history of the experimental stage of West Indian colonization, when men were aiming at something worthier than piracy, and before the planter society with its basis of slavery was definitely formed. While his main business is to tell the story of Providence Island he throws new light on the general political conditions in the West Indies, especially on the problem of colonial defence as it presented itself to the Spaniards when the northern nations descended on the island outworks of their empire, and also on the attitude of the English to the Central American Indians, in which matter the high standard held up by Pym is of great interest. Something is added, too, to our knowledge of the early career of Pym, and the opinions and activities of the Puritans during the period when Charles I. was governing without a Parliament. Mr. Newton's introduction contains a useful account of the authorities, but his footnotes are less satisfactory. We are often in the dark as to what authority he is relying on or what document he is citing.

E. A. B.

GENERAL.

British Empire.

'The Oxford Survey of the British Empire.' Edited by A. J. Herbertson, M.A., PH.D., and O. J. R. Howarth, M.A. 6 vols. Oxford: Clarendon Press. 1914. £3 10s.

These six volumes form a substantial and most valuable compendium of information on the present conditions of the British Empire. The first volume is given to the British Isles and our Mediterranean possessions; a volume each to our African, Asiatic, American, and Australasian possessions; and the last volume, entitled a general survey, contains a group of articles on historical, administrative, military, and other topics. To assign a volume to each continent, treating America as one, is probably the most satisfactory division of the space available, though the inevitable result is that India hardly gets its due share, while some small possessions like Papua and the Falkland islands are very handsomely treated. The description of India's great agricultural industry is compressed into twenty pages. The chapter on its industrial and economic conditions is more satisfactory, and gives a very useful account of modern economic changes. The brief chapter on Western influence seems to take insufficient account of the economic causes that underlie the political unrest. There is so much good literature about India that the economic and political parts of this volume, with the exception of Mr. Cotton's chapter on industrial and economic conditions, are too summary to be of much value. To the American volume Prof. James Mavor, of Toronto, has contributed a valuable and original survey of the economic conditions of Canada. It is interesting to note that the experience of the last ten years confirms him in the cautious position he took up in his Report to the Board of Trade in 1904 as to the possibility of wheat production in the north-west. It seems a pity that the American volume and the African volume also do not include a chapter on physical features in their bearing on the course of settlement such as Mr. Griffith Taylor has contributed to the Australasian volume, in view of the great influence which geographical conditions have exerted on colonization in both Canada and South Africa. The treatment of Australia is very good, the matter is well arranged and provides an account of Australia's economic development which it is not easy to find elsewhere. For this we are very grateful, though, on the other hand, the description of the government and administration is a mere historical sketch. This volume, too, is more profusely illustrated with maps than any of the others, which adds considerably to its value.

The general volume is somewhat of a miscellany, though it contains much matter of great interest and usefulness. Sir Charles Lucas contributes a valuable chapter on the development of our colonial administration. Professor Egerton summarizes in a readable narrative the story of the upbuilding of the empire. This is the only historical chapter in the whole work, and the editors have probably been wise, in view of the pressure upon their space, in excluding history and confining their attention to geography, economics, and administration. Not the least interesting of these general contributions is Mr. Sargent's chapter on our common educational problems. A very brief chapter is devoted to some aspects of imperial commerce, communication, and migration—subjects that might well have claimed a larger share of attention, especially as they receive very little in the other volumes. The treatment of migration is very scanty, and the Asiatic immigration question is hardly discussed, though Professor

Mavor has dealt with it from the Canadian point of view in his economic survey of Canada. Similarly, in regard to trade, the last volume offered an opportunity for filling what appears to be somewhat of a hiatus in the general plan—the absence of any adequate account of the empire's trade. British trade receives consideration in a separate chapter, but Canadian trade is described in half a page, and Australian receives little more. It is a little disappointing that the general volume which contains much good work should be so weak on the economic side, and also should fail to give an adequate discussion of the general problem of imperial unity.

It is impossible to review separately all the subjects treated of in this far-reaching survey. It must suffice to say that as a whole it is well planned, and that great pains have evidently been taken to secure the collaboration of men who are authorities on every part of the subject. It is a much-needed work, and ought to be in every library, for we have nothing similar on the same scale. It is well illustrated with coloured and plain maps and with a number of well-chosen plates. Each volume is separately indexed, and in each a few pages are devoted to a summary of the more important contemporary statistics. Concise bibliographical notes at the end of each chapter indicate the more useful modern works on the subject of the chapter. We note what appears to be a misprint on p. 226 of vol. 4, where 1767 should be 1763. E. A. B.

Colonial Empires.

'Spanien und Portugal als See und Kolonialmächte.' Von Dr. Kurt Simon. Hamburg: Richard Hermes Verlag. 1913. Pp. 320. 4 *Sketch-maps*. *Price M*4.70; *bound, M*5.50.

Dr. Simon has written a very interesting work, in which he sketches the history of Spanish and Portuguese colonization, and discusses the various factors which affected the position of these countries as sea powers, the relations of Portugal with Spain and of the latter with central Europe and the Mediterranean. While his collection of historical facts is of great value, many essential points are not sufficiently brought out, such as the inherent weakness of the Spanish colonial dominion. It did not consist of colonists from the mother country maintaining themselves by the work of their own hands; but of a huge territory rapidly conquered, the greater part within the tropics, in which the Spanish emigrants lived mostly by the labour of the natives, and a host of half-breeds rapidly sprang up whose descendants had little sympathy with the mother country, which sought only to exploit them. The author's theoretical propositions also are hardly to be trusted; he is too apt to assume that what did not happen could not have happened. An opinion that he especially insists on is that the importance of the command of the sea is greatly exaggerated, for that the possession of territory must be decided by land forces.

Commercial Geography.

'Industrial and Commercial Geography.' By I. Russell Smith. Pp. xi., 914. New York: Henry Holt & Co. 1913. $4. 8½ × 6.

Those of us who had the pleasure, some ten years ago, of reading Dr. Russell Smith's 'Organization of Ocean Commerce,' published by the University of Pennsylvania in its Political Economy and Public Law Series, have been waiting for some such work as this from the same pen; and now that it is forthcoming, it is certainly a notable work. Dr. Russell Smith is Professor of Industry in the Wharton School of Finance and Commerce, and his attitude to his subject is

essentially industrial, financial, commercial. In his preface he says that he aims "to interpret the Earth in terms of its usefulness to humanity," but he means the economic rather than the geographic Earth. Thus even in an initial chapter on Agriculture he does not attempt to discuss the fundamental geographic basis, nor is there in the index any such heading as "soil" or "temperature." At the same time there is in the book an immense amount of sound, suggestive, and up-to-date material of an essentially geographic nature; and one feels conscious, in reading it, of the true geographic atmosphere in spite of the absence of direct geographic treatment.

The first part of the book, *i.e.* nearly 700 pages of it, deals with "Industrial Geography," concerned both with products and with processes, but avoiding any regional treatment—which, the author says, involves too much repetition. The lines of treatment are unusually fresh and distinctly illuminating, all kinds of interesting points being raised or fully discussed, *e.g.* the relative importance of "cash" and "supply" crops, the influence of machinery on the distribution of wheat, the amount of labour involved in rice-culture, the usefulness of maize on *rough* land, the varying ratio of meat animals to man, the influence of Slav immigration on the production of beet-sugar in U.S.A., and so on. All such topics are consistently treated from the economic point of view, but it is never non-geographical, and the wealth of pertinent illustrations is generally most suggestive to the geographer. In treating of the processes, Professor Russell Smith is rather less happy. Indeed, in his account of British shipbuilding he is almost baldly economic, and neither satisfying nor sound on the geographic side. But even here he is still interesting and suggestive.

In Part II., "Commercial Geography," he extends and amplifies the essential basis of his old thesis; and it must have been no small gratification to him, in surveying present-day actualities, to find such consistent confirmation of his own anticipations of ten years back. Some of the chapters here, *e.g.* "The Trade Centre: its Development" and "The Work of the Trade Centre," seem to the present reviewer no great advance on "The Golden Gates of Trade," etc., which Dr. Yeats published through Messrs. Philip twenty-five years ago; but, to any one not familiar with Dr. Yeats' series, they would no doubt seem as illuminating and suggestive as other parts of the work.

But the greater part of this section is devoted to Trade Routes; and here, especially on the oceanic routes, the book is quite admirable—so much so that, in spite of its somewhat unwieldy size and shape and its considerable cost, it will probably prove to be indispensable to the teacher of geography for daily use. Though Prof. Russell Smith seems nowhere to discuss definitely either the relation of "natural" advantages to efficiency and cheapness of transport, or the relation of great distances to railway carriage, he supplies a wealth of evidence on both points, especially—as is natural—from North America. And from what he says about his own country, it seems certain that he would support the belief that, *e.g.*, such a route as the "Cape-to-Cairo" must be largely a *water* route.

In avoiding regional treatment as involving too much repetition, Prof. Russell Smith has not avoided the repetition; and there is a considerable amount of material in which the geographer will not be deeply interested. But some of the more important subjects are worked out with a wealth of detail which, if somewhat tedious, makes the treatment convincing; and this is one of the great merits of the work.

In style and general get-up the book is excellent. The type is clear and bold; the illustrations, though often not quite new, are numerous, appropriate, and

topical; the bibliography is very fair; and the spelling of place-names, if far from scientific, is that usually found in commercial reports of all sorts. The one really weak point is the index, which is very feeble. This is surely a grave defect in a book which avoids all regional arrangement over fully seven-tenths of its pages, and which is a really bulky treatise. Fairly exhaustive tests show that not even North America is properly indexed; and, though it may be an excellent plan to make one's own index to a book, it is plain that such a process is practical only with the smallest book, certainly not with a book that approaches 1000 pages and weighs over 50 ounces.

THE MONTHLY RECORD.

EUROPE.

Sea Encroachment at Malta.—The *Royal Engineers' Journal* for May of this year contains an account by Captain C. W. Biggs, R.E., of a recent somewhat serious encroachment of the sea at Fort Ricasoli, Malta, and of the measures taken to cope with it. The paper is illustrated by plans and photographs. The site of the encroachment is a line of weakness, due apparently to a fault in the rock structure, traversing the peninsula on which Fort Ricasoli is placed, on the north-east of the Grand Harbour. The trace of the bastion walls built by the knights of Malta about 1670, shows that even then the inlet on the line of fault existed. The winter storms have gradually eaten into the fault and burrowed a tunnel beneath the cliff, from which a sort of chimney was formed leading to the parade ground above. Measures were therefore necessary to stop the encroachment, the proposal adopted being one for the creation of a breakwater across the mouth of the inlet by means of a number of concrete blocks chained together. The work has been continued for several successive years, the comparatively small blocks used at first proving inadequate to withstand the heavy seas. Some were washed out to the front, while others sank in the sand. The weight of the blocks was progressively increased until at last it reached fifty tons each, and this seems to have had a satisfactory result. Although some of the blocks have been shifted by the winter storms, this has now taken place *inwards*, while the sea has helped to defeat itself by piling up material behind the breakwater. All that is thought necessary for the future is the addition of more large blocks from time to time, and continued filling in behind them.

ASIA.

Survey of the Southern Palestine Borderland.—With a view to prolonging the original survey of the Palestine Exploration Fund to the Egyptian frontier, and so connecting it with recent work of the Egyptian Survey Department, a survey has been carried out under the auspices of the same Fund by parties headed by Captain S. F. Newcombe, R.E. In a report, written at Akaba in February of this year and printed in the July number of the *Quarterly Statement* of the Fund, Captain Newcombe describes the general programme of the survey, and the progress of the work to date, while a postscript written in June records the return of the party to this country after completing its labours. The area in question was but imperfectly known, and the results are of some interest apart from their purely cartographical value. Five parties were engaged in the work, and the map was made on the scale of 1:125,000, roughly contoured at 100-feet intervals. A triangulation was effected, the fixed points of the Sinai boundary determined by the Egyptian survey being carried further east, while in the north a chain of triangles was carried across to connect with the original Palestine survey. In the south it

was possible to save time and expense by observing large triangles, the exterior points—Mount Hor and Jebel Taba—being observed from two mutually visible fixed points over 40 miles apart on the Egyptian frontier, and a framework thus supplied into which subsidiary points could be easily fitted. The main difficulties encountered were concerned with transport, and the procuring of guides and supplies, with a certain amount of hostility on the part of the Arabs, but these were on the whole successfully overcome. A small area near Akaba had to be left unsurveyed owing to the unwillingness of the Turkish authorities to give the required permission. This was, however, mapped by Major Kitchener in 1883. The summit of Mount Hor (where the size and bright colouring of "Aaron's tomb" were a distinct aid in the observation of rays over 55 miles in length) was fixed, relatively to the Sinai survey, with a probable error of only 30 feet. The other results of the survey are mainly concerned with archæology, in the interests of which Messrs. Woolley and Lawrence, archæologists connected with the British Museum, were attached to the expedition for part of the time. Special care was devoted to the accurate collection of names of localities, which were taken down, as pronounced by the guides, by an educated Syrian of the party. That of "Theigat el-Amirin," thought by Prof. Palmer to be possibly a relic of the Amorites, turned out to refer to a tribal fight of about 150 years ago between the Azazma and Amiri tribes. The Bedawin of this desert region seem to have moved there only within the last 500 years. All roads have been inserted in the new map, and a point of interest is the discovery that the direct route from Kadesh to Mount Hor is an easy road, though thought by earlier writers to be impossible.

Kinthup's Exploration of the Tsang-po.—Before the recent explorations of Captains Bailey, Morshead, and others, there was a tendency to belittle the work of the native explorer Kinthup as inaccurate and untrustworthy; and, considering that he was not a trained surveyor, it would not have been surprising had his results not stood the test of critical examination. But, as already mentioned in the *Journal*, the means of testing his descriptions for the first time supplied by the recent explorations have put matters in a very different light. The high opinion of his merits expressed by Captain Bailey on his return is fully borne out by the detailed comparison of the earlier and later work which has been made in the Indian Survey Department, and reported in a 'Note in Vindication of Kinthup,' by Captain G. F. T. Oakes, R.E., which has lately been issued at Dehra Dun. Captain Oakes remarks that "Kinthup's work has proved distinctly satisfactory; in fact, considering that he carried the whole in his memory until his return four years after his departure, it is remarkable. . . . All his names east of Tsetang, nearly 150 in number, have now been identified, with the exception of about twenty, which include many caves and camps, and villages probably since abandoned. The descriptions of parts of his route are often most accurate, and sometimes could not have been given more accurately in as few words." For a few stages after his escape from captivity his route report was not good, but here his first care was evidently to make good his escape. As regards his much-discussed falls of the Tsang-po, it became obvious from Captain Bailey's first report, as noted in the *Journal* at the time, that there was a confusion between the falls on the main river and those of the side stream which enters opposite Gyala. This may have arisen in the course of dictation and translation. In the Abor country many more of his names can be satisfactorily identified than was supposed by Mr. Bentinck (*Journal*, vol. **41**, p. 106). His terminal point, Onlow or Onlet, is now given as Olon or Milang, and inquiry at this village has shown that the memory of his visit still survives. In this region he made only two geographical mistakes of importance, one being the mistaking of the Yamne valley for that of the Dihong; and Captain Oakes remarks that it is easy for even

trained topographers to make such mistakes amid the mist and rain and deceptive hill features of the Abor country. His position of Damro (the alternative name for which—Padam—partly justifies his "Miri Padam") was only 19 miles south-west of its true position, a remarkable fact when it is considered that his work was carried down over 200 miles from Tibet. The expedition of 1894, which advanced only some 25 miles from the plains, placed it 14 miles too far north. Very rightly, Captain Oakes concludes, have his experiences been described as a "romance of the Survey of India."

Dzungaria.—Mr. Perry Ayscough writes to point out that the reviewer of the work 'With the Russians in Mongolia,' in the *Journal* for June last (p. 684), is mistaken in stating that the map appended to the book includes Dzungaria in Mongolia. But though it is true that the name Dzungaria is placed in the map just outside the limits of Mongolia as defined by the red border, it is none the less the fact that the whole northern portion of the area generally known as Dzungaria—between the Mongolian Altai and the Tian Shan—*is* placed within the red boundary-line, and this tract, the reviewer maintains, is part of the Chinese province of Sin Kiang, and should not be included in Mongolia.

French Surveys in Indo-China.—It is now some years since the systematic prosecution of surveys, geodetic and hydrographical, was inaugurated by the authorities of French Indo-China. Considerable progress has since been made, and the report on the work accomplished in 1911–12 contains matter of particular interest. During that season the geodetic work was completed to the line running through Khong and Battembang, and by it the Mekong meridional series of triangles was definitely connected with the English triangulations carried out by MacCarthy in Northern and Southern Siam respectively, and with the survey work of the Franco-Siamese missions, which depended on MacCarthy's northern triangulation. It is thus of particular interest to institute a comparison between the results obtained by the two organizations, which has now become possible. The agreement brought out between them, as also with the results of astronomical observations for latitude and azimuth carried out at Phnom-Kaduong by Captain E. Benoit, of the French Colonial Artillery, is most striking and satisfactory, as is shown by the following figures:—

COMPARISON OF VALUES.

	Latitude, Phnom-Kaduong.	Azimuth, Phnom-Kaduong—Saido.
Indo-China Series	13° 00′ 58″·9	... 84° 21′ 26″·5
MacCarthy	13° 00′ 55″·3	... 84° 21′ 52″·9
Astronomical	13° 01′ 04″·7	... 84° 21′ 09″·1

	Verificatory base, Prabat—Sabat.	Difference.
Indo-China Series	32,096·43 m.	3·59 m.
MacCarthy	32,092·84 m.	

The surveys of the two Franco-Siamese delimitation missions agree both with each other and with the Indo-China series, and the errors involved in the above figures on maps made on the scale of 1 : 200,000 are inappreciable. The slight divergencies in the values given above constitute a remarkable result, both as between the data of the Indo-China series and of MacCarthy, and between the astronomical and geodetic latitudes of Kaduong—the latter obtained by a series of triangles brought from the astronomical position of Cap Saint Jacques determined by officers of the French Hydrographic Survey. The satisfactory character of the closing differences, in the case of elements with entirely different sources of origin, confirms the opinion that the French geodetic operations in Indo-China deserve to take a fair place among similar operations in France.

AFRICA.

Mission Stations on the Upper Zambezi.—The last journey to Central Africa made by the late Mr. F. S. Arnot was for the purpose of founding a new mission station on the Kabompo, one of the headwaters of the Zambezi. In this he was accompanied by Mr. T. L. Rogers, a young graduate of London University and a trained engineer, who, we understand, is now carrying on Arnot's work on the upper Zambezi. He has lately made a journey of some 300 miles to the west of the Zambezi and south of its tributary, the Lungebungu, in order to assist in the founding of a new station for the South Africa General Mission. From a sketch-map of the route which has been communicated to us, it appears that the new station is on the south bank of the Luanginga, a western tributary entering the Zambezi south of the Lungebungu. During the journey, which led generally along the south bank of the Lutembwe (a southern tributary of the Lungebungu), Mr. Rogers accidentally diverged from the direct route and struck a stream — the Luambimba—which has not previously been shown on our maps. According to his sketch, it runs generally south-east between the Lutembwe and the Luanginga, joining the latter before it enters the Zambezi.

AMERICA.

Eruption of Lassen Peak, California.—The exhibition of volcanic activity by Lassen peak during the past summer, from May 30 onwards, is a phenomenon worthy of note, as it appears to be the first recorded instance of undoubted volcanic activity actually witnessed within the United States proper. Such at least is the belief of Mr. R. S. Holway, who has taken much pains to collect authentic reports of the eruptions, and has made a preliminary report issued as No. 7 (vol. 1) of the 'University of California Publications in Geography,' accompanied by excellent photographs. Lassen peak lies in Northern California, at the southern extremity of the Cascade range. The southern 50 miles of this range is a great volcanic ridge, about 25 miles wide, studded with minor volcanic cones and culminating in Lassen peak, with an elevation of 10,437 feet. The latest previous eruption was placed by Diller some 200 years ago, when a flow of lava issued from Cinder cone, 10 miles north-east of the main peak, and the recrudescence of activity was recognized by the same writer as a possibility. When the recent eruptions began, the snow was still deep on the peak, and the summer influx of cattlemen and others into the district had not yet begun. The first reports therefore lacked precision, but trustworthy observations were soon forthcoming through the energy of the officials of the U.S. Forest Service, which had a fire look-out station on the very summit of the peak. Various accounts show that a vent was formed measuring 275 feet in length, and that sand, rocks, and mud were ejected, together with heavy volumes of steam and smoke, and sometimes fine ashes. One of the heaviest eruptions was on June 14, when a party of visitors who had reached the crater were obliged to run for their lives, one of them sustaining somewhat serious injuries. A noteworthy peculiarity of the eruptions was that all the rocks and ashes were cold or only lukewarm, and snow covered by the ash was still to be seen in considerable quantity close to the crater on June 24. No freshly molten lava was seen, and the only heat noticeable was that of the escaping steam. Altogether twenty different outbursts were witnessed down to July 15.

AUSTRALASIA AND PACIFIC ISLANDS.

The Routledge Expedition to Easter Island.—News of this expedition, dated August 10 last, reached this country about the middle of October. Mr. Routledge says little as to the scientific work so far accomplished, merely observing

that the remarkable antiquities of the island were being examined by the party. He gives some account of disturbances in the island, due to unrest among the native Kanakas, about 250 in number. The main or only industry of the island—cattle rearing—is carried on by a company under the direction of an English manager, the only permanent white resident. Thefts of cattle and other property of the company had already been rife, when the natives put in a claim to the possession of all the cattle on the island—some 15,000 head—and began to destroy them wholesale. Such was the state of affairs, when the Chilean warship which visits the island every two or three years put in an opportune appearance, and for the moment relieved the situation. Four of the ringleaders were deported, but Mr. Routledge is inclined to anticipate further trouble. He describes the natives as unenterprising, and loth to work even for their own living.

POLAR REGIONS.

Dr. Bruce's Spitsbergen Expedition.—Dr. Bruce, whose departure for Spitsbergen early in the summer for hydrographical work in Wybe Jansz water was mentioned in the August number, p. 233, has returned to this country after a somewhat disappointing expedition due to the exceptionally unfavourable ice conditions. Reaching Tromsö, he chartered the *Pelikane*, a sailing boat of 46 tons, strongly built and well fitted for ice-work. In this he went north in a straight course to Wybe Jansz water, but found it completely blocked with heavy ice. Skirting the tight ice from the Thousand islands, he passed through heavy pack to the south of South cape, finding the tight ice to extend 40 miles south and almost as far to the west of the latter. Only a powerful steamer could have forced its way through such heavy ice, and it was therefore decided to go round to Green harbour in Ice fiord, and there discharge a cargo of paraffin for the Norwegian wireless station. The vessel passed through heavy ice off Horn sound and again west of Bell sound, and had considerable difficulty in working through it. It was all heavy polar pack, and had evidently come from the north-east, drifting round to the south end of Spitsbergen and filling up Wybe Jansz water, then passing up the west coast of the group. Dr. Bruce had never met so much and so heavy ice in all his voyages to Spitsbergen. Reaching Green harbour on August 13, he there first got news of the war, meeting also his old friend Captain Staxrud, the Norwegian explorer. To go back to Wybe Jansz water seemed out of the question, and he therefore decided to return after first proceeding to Cross bay, where the owner of the ship had to deliver coal to the German meteorological station there. Delays occurred through bad weather and bad navigation, the vessel going ashore in Foreland sound and being only got off with difficulty. Dr. Bruce and two of his party went ashore on Prince Charles foreland, and added somewhat to the knowledge of its geology. A few oceanographical and meteorological observations were taken, and a start made for home, Norway being reached on September 9.

GENERAL.

Effects of Continental Glaciation on Agriculture.—A subject of great interest is discussed by Prof. O. D. von Engeln in the *Bulletin* of the American Geographical Society for April and May of the present year. After referring to the somewhat vague and general statements often made as to the influence exerted by the Pleistocene glaciation on the course of civilization in the countries round the North Atlantic basin, by reason of the natural advantages, particularly in relation to agriculture, derived therefrom, the writer attempts a more special study of the question on the basis of statistics which are available for limited parts of the whole glaciated area. He shows that, other things being equal, a distinct advantage seems to lie with the glaciated as compared with the non-glaciated

portions of the Eastern United States. The former, it is true, are regions of glacial *deposition*, and in areas where glacial *erosion* predominated (such as Norway, or the Laurentian plateau of Canada), the reverse effect is no doubt to be traced. But here the climatic conditions are in any case unfavourable to agricultural development of a high order. Discussing the effects of glaciation on relief, the writer finds that where this has been heightened (as by the steepening of valley slopes or the formation of lakes), such effects are to some extent detrimental. On the other hand, the general smoothing of the normal irregularities of pre-glacial relief has exercised a decidedly favourable influence. Another advantage consists in the conservation of underground water-supply by drift deposits. The acknowledged greater fertility of glacial soils is due to several causes. Being made up of mechanically derived detritus—a mixture of all the materials from many rock-types—they contain a higher percentage of the soluble mineral plant-foods than the non-glacial soils, which are in the main chemically-derived insoluble residues. The level topography of the drift-plains has also resulted in a deep accumulation of organic matter. The wide variety of conditions under which material was deposited by the ice has given rise to a great textural diversity of glacial soils, and this greatly favours intensive and diversified agriculture. Even outside the actually glaciated areas the deposit of loess carried from the latter by the wind has benefited agriculture. The formation of glacial lakes has no doubt withdrawn a large area from the domain of possible agriculture, but on the other hand the climatic effects of the presence of such lakes have been beneficial. This is especially the case on the leeward side (east and south) of the great American lakes, and Michigan is particularly favoured as lying between two large bodies of water, which give it a markedly insular climate. Again, the floors of former glacial lakes, now drained and filled, possess a deep and fertile soil, with level topography and uniform texture, rendering them very susceptible to cultivation by mechanical power. The writer's general conclusions are summed up as follows: "The beneficial effects on agriculture, due to glaciation, are of wide variety and apparently outweigh detrimental influences due to the same cause. As a net result, glaciated lands are, therefore, of greater agricultural value and utility than non-glaciated areas under otherwise essentially similar conditions."

Diploma in Geography at London University.—Regulations for examinations in and after 1916 for the Academic Diploma in Geography granted by the University of London have lately been issued. The diploma course is open both to matriculated students of the university and to graduates of other universities who fulfil certain conditions. Students are required to attend a special course of study approved by the university, and including (*a*) the physical basis of geography, including the elements of physical geology, geomorphology, and climatology; (*b*) the use of instruments and methods of map-making; (*c*) map-reading and map-correlation, including practical work in the field and the presentation of a short dissertation on a selected area of the United Kingdom; (*d*) general regional and historical geography, with a special study of two of the continents. The examination will be held annually, beginning on the first Monday in July. For the purposes of the examination the whole field is arranged under three heads, the subdivisions (*b*) and (*c*) above being combined as one subject, and candidates shall not be approved unless they have shown a competent knowledge in each of the three subjects so formed. The fee for each student for each entry to the examination is £5.

OBITUARY.

Sir Henry Bulwer.

We much regret to record the death of Sir Henry E. G. Bulwer, G.C.M.G., who, as Fellow of our Society since 1892, member of its Council from 1899 to 1908, and Vice-President during the last four years of his term of office, had taken a warm interest in its affairs and prosperity. He died on September 30, 1914, at Heydon, Norfolk, in his 78th year, the cause being heart-failure. The funeral took place at Heydon church on October 4, in the presence of a large gathering of relatives and others.

Sir Henry came of a distinguished family, the reputation of which was worthily maintained by his own career. He was the youngest son of William Earle Lytton Bulwer, of Heydon Hall near Norwich, and Emily, daughter of General Gascoyne. He was nephew to the diplomatist Sir Henry Lytton Bulwer, afterwards Lord Dalling and Bulwer, and to the first Lord Lytton; and both his elder brothers had distinguished military careers, the second being the late General Sir Edward Bulwer. He was educated at Charterhouse and at Trinity College, Cambridge, and after taking his degree in 1859, took service under Government as Official Resident in the Ionian islands under the Lord High Commissioner; a post which he held till 1864. He next went to Constantinople as private secretary to his uncle, Sir Henry Lytton Bulwer, then British Ambassador at Constantinople. The rest of his official career was entirely devoted to the outlying parts of the British Empire, in which he proved his capacity as an able administrator. After holding responsible posts in Trinidad and Dominica, he became Governor and Commander-in-chief of Labuan (Borneo) in 1871, passing in 1875 to Natal as Lieut.-Governor, and becoming Governor and Commander-in-Chief of the same colony in 1882, and at the same time Special Commissioner for Zulu affairs. From 1886 until his retirement in 1892 he was High Commissioner in Cyprus.

Sir Henry impressed all who came in contact with him by his courteous and dignified bearing, recalling the manners of a bygone age. From the time of his first joining the Council of the Society he took a consistent interest in its Library, regularly attending its committees, and on various occasions making gifts of rare old volumes, which were a valuable addition to its treasures. The latest and perhaps most prized of all was given only a few months before his death, consisting in the rare edition of the Mercator-Hondius Atlas described in the *Journal* for August of this year (p. 235). Other gifts were the English translation of Martin Cortes' Spanish work on the 'Art of Navigation' (1596), and Hakluyt's Latin edition of Peter Martyr's 'Decades' (1587).

Captain H. S. Toppin.

One of the early victims of the fighting in France during the present war, Captain Toppin was favourably known to geographers for his excellent survey work in more than one imperfectly mapped part of the world. Born in 1874, the son of Major-General J. M. Toppin, late Royal Irish Regiment, he joined the Northumberland Fusiliers in 1895, serving in the Nile Expedition of 1898 and being present at the battle of Khartum. He took part in the South African war, was favourably mentioned in despatches, and received the medal with seven clasps. He was afterwards engaged on the Survey of Uganda, doing excellent

work, and on the organization of a party of British officers to represent Peru in the demarcation of the boundary of that country with Bolivia early in 1911, was appointed Assistant-Commissioner under Lieut.-Colonel Woodroffe. On the departure of his chief for Brazil, Toppin took his place as chief Commissioner on the Peruvian side. He carried out both the administrative and technical work of the commission admirably, and in particular his work raised an interesting question as to the attraction exercised by the Andes. Before his appointment to the Uganda Survey he had gone through the Society's course of instruction in surveying and had taken the diploma. His associates always found him a pleasant man to work with, and he was a capable and keen officer. His loss is greatly to be regretted.

Dr. H. J. Johnston-Lavis and Prof. G. Mercalli.

Within the present year we have lost two of the most noted students of Vesuvian phenomena, and both by accidental deaths. Prof. G. Mercalli lost his life during the burning of his house at Naples on March 19; Dr. Johnson-Lavis in a motor accident near Bourges on September 10. Both devoted their attention largely to the eruptions and changing conditions of Vesuvius; both contributed valuable memoirs on seismological and other subjects.

Dr. Henry James Johnston-Lavis, who was the more widely known in this country, was born on July 9, 1856. He received his medical education at University College, London, where he also studied geology under Prof. John Morris. He was elected a fellow of the Geological Society in 1875, at the unusually early age of nineteen, and in the following year his first paper was published in the *Quarterly Journal* of the Society. In 1880 he went to Naples as a consulting physician, and from this time onwards papers on Vesuvius and volcanic phenomena predominate among his writings. Between the years 1885 and 1895, he contributed eleven reports to the British Association on the volcanic phenomena of Vesuvius, this useful work being suspended in the latter year, when he left Naples for Beaulieu-sur-Mer on the Riviera coast. A pamphlet published by Johnston-Lavis two years ago gives the titles of 161 books and papers. His chief work is, no doubt, his valuable 'Monograph of the Earthquakes of Ischia,' which he published by subscription in 1885. In this he applied the methods devised by Mallet to the Ischian earthquakes of 1881 and 1883; and, owing to the small depth of the focus in each case, he applied them with considerable success. Dr. Johnston-Lavis has left his mark as a skilled and careful investigator, an enthusiastic student, and a kindly man.

Prof. Giuseppe Mercalli, who was born at Milan on May 21, 1850, was one of the most eminent of Italian seismologists. In 1883 he published a volume on the 'Vulcani e Fenomeni Vulcanici in Italia,' forming the third part of Negri, Stoppani, and Mercalli's 'Geologia d'Italia.' In this and other memoirs all the volcanoes of Italy are studied, but in this branch of science Mercalli is chiefly known for his continuous study of Vesuvius, extending from the time when Johnston-Lavis left Naples for a period of nearly twenty years. Many of the great earthquakes of the south of Europe were investigated by Mercalli, especially the Ischian earthquake of 1883, the Andalusian earthquake of 1884, the Riviera earthquake of 1887, and the Calabrian earthquake of 1894. In 1902 he proposed the useful Mercalli scale of seismic intensity, which, in Italy and other countries, has displaced the well-known Rossi-Forel scale. His memoirs on regional seismology are of the highest value, especially his general catalogue

of Italian earthquakes from B.C. 225 to A.D. 1859, and his detailed lists of the earthquakes of Calabria and the Riviera. Generous to all his fellow-workers, Mercalli will be remembered, not only as an authority on seismological geography, but for his influence in training and inspiring younger men.

C. DAVISON.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Gen. = Genootschap.
Ges. = Gesellschaft.
I. = Institute, Institution.
Int. = International.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
Jber. = Jahresbericht.
k.(k.) = kaiserlich (und königlich).
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is $10 \times 6\frac{1}{4}$.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Albania—Early maps. *B.R.S.G. (Rome)* V., 3 (1914): 601–637. **Almagià.**

Le più antiche rappresentazioni cartografiche della regione albanese. By Roberto Almagià. *Maps and facsimiles.*

Alps—Mont Blanc. **Lucerna.**

Petermanns M., Ergänzgshft. 181 (1914): pp. vii. and 188.

Morphologie der Montblancgruppe. Von Dr. Roman Lucerna. *Map and Illustrations.*

Austria—Bohemia—Morphology. **Daneš.**

Sbornik České Spol. Zem. [*J. Bohemian G.S.*] 19 (1913): 1–18.

Morfologicky vývoj strédních Čech. Napsal Dr. J. V. Daneš.

Austria—Dalmatia. *B. Minist. Affari Esteri* (1912): 473–586. **Alia.**

La Dalmazia. Per Cav. Antonino d'Alia.

Baltic. **Witting.**

Finländische Hydrographisch-Biologische Untersuchungen. No. 12. Jahrbuch 1912, enthaltend hydrographische Beobachtungen in den Finland umgebenden Meeren. Von Dr. Rolf Witting. Helsingfors, 1913. Size $13 \times 9\frac{1}{2}$, pp. 130. *Sketch-maps and Sections.*

France—Alps—Glaciers. **Ministère de l'Agriculture.**

Ministère de l'agriculture. . . . Service des grandes forces hydrauliques. (Régions des Alpes et du Sud-ouest.) Étu les glaciologiques. Savoie-Pyrénées. Tome 2.

N.P. 1912. Size 11 × 7½, pp. viii. and 166. *Sketch-maps, Diagrams, and Illustrations.*

France—Corsica—Rainfall. **Bénévent.**
Recueil Travaux I.G. Alpine (Grenoble) **2** (1914): 239–264.
La pluviosité de la Corse. Par E. Bénévent. *Sketch-map and Diagram.*

France—Drôme. *Ann. G.* **23** (1914): 127–150. **Faucher.**
La plaine de Valence. (Bas Dauphiné.) Par D. Faucher. *Illustrations.*

France—Haute-Vienne and Corrèze. *Ann. G.* **23** (1914): 80–83. **Castelnau.**
Sur le relief du Haut Limousin. Par Paul Castelnau. *Illustrations.*

France—Hérault—Fisheries. *Ann. G.* **23** (1914): 31–44. **Sabde**
La vie de pêche littorale entre Agde et Aigues-Mortes. Par Fernand Sabde.

France—Nord. *B.S.G. Lille* **61** (1914): 34–49; 94–110; 162–171. **Laude.**
Influence de la région minière sur les cultures, les modes de culture et la population de la région de Saint-Pol. Par F. Laude. *Sketch-maps.*

France—Pelvoux—Glaciation. *La G.* **29** (1914): 114–119. **Rabot.**
Les glaciers du versant nord-est du massif du Pelvoux au début du XIX^e^ siècle. Par Charles Rabot.

France—South-east—Morphology. **Allix.**
Recueil Travaux I.G. Alpine (Grenoble) **2** (1914): 1–185.
La Morphologie glaciaire en Vercors. Par A. Allix. *Maps, Illustrations, and Sections.*

Germany—Black Forest. **Scheu.**
Der Schwarzwald. Von Dr. Erwin Scheu. (Deutsche Landschaftstypen, Heft I.) Leipzig, 1914. Size 10 × 7, pp. 12. *Illustrations.*

Germany—Dunes. *M.G. Ges. München* **9** (1914): 231–365. **Jessen.**
Morphologische Beobachtungen an den Dunen von Amrum, Sylt, und Röm. Von Otto Jessen. *Map and Illustrations.*

Germany—Rhön. **Dietrich.**
Die Rhön. Eine Morphologie des Gebirges. Von Dr. phil. Bruno Dietrich. (From 92. Jahresber. Schles. Ges. für vaterl. Cultur.) Breslau, 1914. Size 9½ × 6, pp. 68. *Sketch-map, Illustrations, and Sections.*

Germany—Thuringia—Morphology. **Passarge.**
M.G. Ges. Hamburg **28** (1914): pp. 221.
Morphologie des Messtischblattes Stadtremda. Von Prof. Dr. S. Passarge. *Maps, Sections, and Illustrations.*

Gulf of Bothnia—Glaciation. *Fennia* **33** (1912–1913); No. 3, pp. 364. **Hellstrom**
Bidrag till Kännedomen av Isförhållandena i Bottenhavet. Av Rafael H. Hellstrom. *Sketch-maps.*

Holland—Coast. *Ts. K. Nederl. Aardr. Gen.* II. **31** (1914): 301–345. **Rietema.**
Over Wierden en Dijken. Schets eener geschiedenis van de Noordzeekust tusschen Lauwers en Eems. Door S. P. Rietema. *Map and Illustrations.*

Hungary—Earthquakes. *Beiträge zur Geophysik* **13** (1914): 283–305. **Réthly.**
Die Erdbebenkarte Ungarns. Von A. Réthly.

Hungary—Soil. *J. Manchester G.S.* **29** (1913): 143–153. **Inkey.**
The formation of the soil of Hungary. By Béla de Inkey. *Sketch-map and Illustrations.*

Iceland. *M.V.E. Dresden* **2** (1914): 989–1040. **Erkes.**
Neue Beiträge zur Kenntnis Inner-Islands. Von Heinrich Erkes. *Illustrations.*

Italy—Apulia. *B.R.S.G. (Rome)* V., **3** (1914): 162–184, 295–326. **Mastrangelo.**
L'industria pugliese e i suoi prodotti. Del dott. Vito Mastrangelo.

Italy—Cotton. *B.R.S.G. (Rome)* V., **3** (1914): 31–77, 116–161, 255–294. **Jaja.**
La questione cotoniera e la coltura del cotone in Italia. Del prof. Goffredo Jaja.

Italy—Lombardy. *B.R.S.G. (Rome)* V., **3** (1914): 403–327, 527–556, 638–659. **Garagat.**
La Geografia fisica della Valtellina. By Aurelio Garagat. *Illustrations.*

Italy—Lombardy—Rainfall. *Mem. G.* 1914: 71–294. **Anfossi.**
Materiali per la climatologia d'Italia. IV. La pioggia nella Regione Lombarda. By G. Anfossi. *Maps.*

Italy—Meteorology. **Eredia.**
Atti R.A. Lincei, Rendiconti (Sc. fisiche) V. **23** (1914): 795–800.
L'influenza della orografia sulla distribuzione mensile della nebulosità. Per Filippo Eredia. *Diagrams.*

Italy—Rainfall and Run-off. *Ann. G.* **23** (1914): 168–171. **Anfossi.**
L'effet utile des précipitations sur l'alimentation des cours d'eau. Par G. Anfossi. *Diagram.*
Results of careful investigation in the Apennines north of Genoa.

Malta. *R. Engineers J.* **19** (1914): 301–308. **Biggs.**
Sea Encroachment, Fort Ricasoli, Malta. By Capt. C. W. Biggs. *Illustrations.*
See Monthly Record, *supra.*

Northern Europe—Climate and Lake-levels. *Ymer* (1913): 424–431. **Wallén.**
Variationer i temperatur, nederbörd och vattenstånd i Nordeuropa. Av Axel Wallén. *Diagrams.*

Norway—Geology. *B. Geol. I. Univ. Upsala* **12** (1914): 40–64. **Högbom.**
Ueber die norwegische Kustenplatform. Von A. G. Högbom. *Illustrations.*

Norway—Hydrology. **River Board.**
Hydrologiske Meddelelser for Kongeriget Norge, utgit av Vasdragdirektøren. Vandstandiagttagelser. Bind VIII. Vandstandiagttagelser i Vossa, Laerdalselven, Aarøelven, Gaula i Søndfjord, Jolstra, Norddalselven, Breimselven, etc. Christiania, 1914. Size 10 × 6½. *Diagrams.*

Norway—Seismology. *Bergens Museums Aarbok*, 1913, Nr. 8, pp. 152. **Kolderup.**
Norges jordskjælv med særlig hensyn til deres utbredelse i rum og tid. Av Carl Fred Kolderup. [German *résumé.*] *Maps.*

Pyrenees. *Ann. G.* **23** (1914): 303–324. **Blanchard.**
La Morphologie des Pyrénées françaises. Par Raoul Blanchard. *Illustrations.*

Rumania—Rainfall. *B.S.R. Române G.* **34** (1913): 192–209. **Elefteriu.**
Repartitiunea normală a precipitatiunilor atmosferice în România. By G. Elefteriu. *Maps.*

Rumania—Speleology. *B.S.R. Române G.* **34** (1913): 74–98. **Ionescu.**
Biospeologia Carpatilor meridionali. By C. N. Ionescu. *Map.*

Russia—Lapland. *Fennia* **33** (1912–1913): No. 2, pp. 34. **Tanner.**
Nautsjok—Karnijok—Luttojok—Nuorttijarvi. Af V. Tanner. *Map and Illustrations.*
Geographical, botanical, and geological observations during a journey through a little-known part of Lapland.

South-East Europe. *Ann. G.* **23** (1914): 45–59. **Haumant.**
La nationalité Serbo-Croate. Par Émile Haumant.

Sweden—Södermanland. *Ymer* (1913): 385–411. **Swedberg.**
De geografiska orsakerna till befolkningsfördelningen i Södermanlands län 1910. Av Sven Swedberg. *Maps.*

Sweden—Wester Norrland. *Ymer* (1914): 138–161. **Ahlmann.**
Hufvuddragen af nedre Indalens morfologi. Af Hans Wilson Ahlmann. *Illustrations.*

Switzerland—Lake of Constance. **Bossard.**
Mitteilungen der Abteilung für Landeshydrographie. Nr. 3. Gutachten über die Regulierung des Bodensees. Von W. E. Bossard. Bern, 1913. Size 8½ × 5½, pp. 78. *Diagrams and Illustrations in separate cover, size* 15 × 10.

United Kingdom—Agriculture. *G.T.* **7** (1914): 316–321. **Roxby.**
The agricultural geography of England on a regional basis. By Percy M. Roxby.

United Kingdom—Dartmoor. *Ann. G.* **23** (1914): 325–338. **Vallaux.**
La "Dartmoor Forest." Par Camille Vallaux.

ASIA.

Aden. *Army Rev.* **7** (1914): 214–220. **Bell.**

The Aden Hinterland. By Major-General Sir J. A. Bell. *Sketch-map.*

Arabia. *M.K.K.G. Ges.* **57** (1914): 32–58. **Hein.**

Südarabische Itinerare. Von Wilhelm Hein. *Illustrations.*

Asia. **Heaton.**

A Regional Geography of the Six Continents. Book II. Asia. By Ellis W. Heaton. London: Ralph, Holland & Co., 1914. Size 7½ × 5, pp. 86. *Sketch-maps and Illustrations. Price* 9*d. Presented by the Publishers.*

Asia—Anthropogeography. **Coles.**

The New Outlook Geography. Edited by W. C. Brown and P. H. Johnson. The Home of Man. Part IV. Asia. By L. A. Coles. London: G. G. Harrap, 1914. Size 7½ × 5, pp. 192. *Sketch-maps and Illustrations. Price* 1*s.* 3*d. Presented by the Publishers.*

Caspian sea—Level. *Ann. G.* **23** (1914): 151–159. **Shokalsky.**

Une dénivellation récente et brusque du niveau de la mer Caspienne. Par J. de Schokalsky. *Diagrams.*

See note in the June number (1914), p. 691.

Central Asia. *Ann. G.* **23** (1914): 1–30. **Herbette.**

Le problème du dessèchement de l'Asie intérieure. Par François Herbette. *Diagram.*

Central Asia. *G.Z.* **20** (1914): 368–383. **Machachek.**

Zur physiographischen Entwickelung Zentral-Asiens in der Quartärperiode. Von Fritz Machatschek.

French Indo-China—Historical. **Cabaton.**

Rev. Hist. Colonies Françaises **2** (1914): 129–220.

Les Hollandais au Cambodge au XVII^e^ siècle. Par Antoine Cabaton.

French Indo-China—Mekong. *Ann. de G.* (1914): 339–350. **Doucet.**

Sur la formation du delta du Mékong. Par E. Doucet. *Sketch-maps and Diagrams.*

French Indo-China—Red river. *B. Économique, Indochine* (1914): 15–45. **Normandin.**

Les crues du Fleuve Rouge. Par A. Normandin. *Diagrams.*

India—Assam and Bengal. *Mem. Geol. Surv. India* **40** (1914): 270–329. **Pascoe.**

The petroleum occurrences of Assam and Bengal. By E. H. Pascoe. *Maps and Illustrations.*

India—Bhils. ——

Battling and Building among the Bhils. London: Church Missionary Society, 1914. Size 7½ × 5, pp. 96. *Illustrations. Price* 1*s. Presented by the Publishers.*

India—Census. *J.R.S. Arts* **62** (1914): 627–639. **Gait.**

The Indian census of 1911. Ethnography and occupations. By E. A. Gait.

India—N.W. Frontier. *Army Rev.* **7** (1914): 22–38. **Marsh.**

The Afridi and Orakzai country. By Major F. G. Marsh. *Map.*

India—Punjab—Irrigation. *J.R.S. Arts* **62** (1914): 611–623. **Douie.**

The Punjab Canal colonies. By Sir James M. Douie.

Malay Archipelago. *Ts. K. Nederl. Aardr. Gen.* II. **31** (1914): 360–388. ——

Plannen voor eene nieuwe Nederlandsche Expeditie tot wetenschappelijk onderzoek van den Oost-Indischen archipel. *Sketch-map.*

Ceram is pointed to as a special field for research (see October number, p. 407).

Philippines—Luzon. *Philippine J. Sc.* **9** (1914): Sec. A, 1–50. **Cox and Argüelles.**

The soils of the Island of Luzon. By Alvin J. Cox and A. S. Argüelles. *Sketch-maps, Section, and Illustrations.*

Philippines—Luzon. *National G. Mag.* **23** (1912): 833–930. **Worcester.**

Head-hunters of the Northern Luzon. By Dean C. Worcester. *Sketch-map and Illustrations.*

Russian Central Asia. *B.R.S.G.* (*Rome*) V., **3** (1914): 368–402, 487–526. **Pullé.**

La colonizzazione russa nell' Asia Centrale. Note di geografia coloniale ed economica, del prof. Giorgio Pullè. *Sketch-map.*

Siam—Geology. *B. Geol. I. Univ. Upsala* **12** (1914): 65–128. **Högbom.**
Contributions to the geology and morphology of Siam. By Bertil Högbom. *Sketch-map, Sections, and Illustrations.*

Turkey—Mesopotamia. *Petermanns M.* **60** (1914): 189–193, 257–261. **Hinricks.**
Ein Karawanenreise von Mösul nach Aleppo vom 9. März bis 25. April 1911. Von Dr. Walther Hinricks. *Maps.*

Turkey—Palestine and Sinai. **Newcombe.**
Palestine Explor. Fund, Quart. Statement (1914): 128–133.
The survey of Sinai and South Palestine. Report by Captain S. F. Newcombe.
See note in the Monthly Record, *supra.*

AFRICA.

Angola—Ovamboland. *B.S.G. Lisboa* **32** (1914): 5–45. **Braz.**
Ovamboland. Par A. C. d'Oliveira Moura Braz.

Angola—Railway. **Habran.**
B.S. Belge Études Col. **20** (1913): 701–715, 836–857; **21** (1914): 348–357.
Le chemin de fer de Lobito. Par Louis Habran. *Maps and Illustrations.*

Belgian Congo—Navigation. *Mouvement G.* **31** (1914): 109–114. **Wauters.**
Le réseau fluvial navigable du haut Congo et les bateaux glisseurs de M. Robert Goldschmidt. Par A.-J. Wauters. *Sketch-maps.*

British East Africa—Geology. **Oswald and others.**
Quart. J. Geol. S. **70** (1914): 128–162.
The Miocene Beds of the Victoria Nyanza and the geology of the country between the lake and the Kisii highlands. By Dr. Felix Oswald and others. *Sketch-map and Illustrations.*

Canary Islands—Historical. *B.A. Sc. Lisboa*, 2ª Cl., 6, 1912 (1913): 210–217. **Azevedo.**
Sobre a expedicão ás Canárias em 1341. Par Pedro de Azevedo.

Congo river—Transport. *B.S. Belge d'Études Col.* **21** (1914): 577–592. **Obry.**
Le fleuve Congo et les transports fluviaux. Par V. Willemoës d'Obry. *Illustrations and Diagrams.*

Egypt. *Cairo Sc. J.* **8** (1914): 90–92. **Murray.**
A Journey from Ras Benas to Qoseir, by G. W. Murray. *Map and Illustrations.*

Egypt—Deserts. *M.K.K.G. Ges. Wien* **57** (1914): 312–321. **Krebs.**
Morphologische Beobachtungen in den Wüsten Aegyptens. Von Dr. Norbert Krebs. *Illustrations.*

German East Africa—Geology. *M. Deuts. Schutzgebieten* **27** (1914): 49–67. **Scholz.**
Beiträge zur Geologie des südlichen Teiles Deutsch-Ostafrikas. Von Dr. Scholz. *Sketch-map and Section.*

Gold Coast. *United Empire* **5** (1914): 622–646. **Clifford.**
The Gold Coast and its Dependencies: the legend and the reality. By Sir Hugh Clifford. *Illustrations.*

Madagascar—Imerina. *Ann. G.* **23** (1914): 60–71. **Carrier.**
Le massif de l'Ankaratra et ses abords (Madagascar). Par Captain A. Carrier. *Sketch-map.*
This district lies south-west of Tananarivo.

Morocco. *Rev. Française* **39** (1914): 357–270. **Demanche.**
La trouée de Taza. Par Georges Demanche. *Sketch-maps.*
On the pass leading from the Muluya to Fez, which forms the natural means of communication between Algeria and the interior of Morocco.

Sahara—Railway survey. *La G.* **29** (1914): 73–113. **Nieger.**
Résultats scientifiques d'ensemble de la mission du Transafricain. Par le capitaine Nieger. *Map and Illustrations.*

South Africa—Magnetism. *T.R.S. South Africa* **4** (1914): 9–56. **Beattie.**
Further Magnetic Observations in South Africa. By J. C. Beattie.

NORTH AMERICA.

America. **Brown and Johnson.**

The New Outlook Geography. The Home of Man. Part III. America. By W. C. Brown and P. H. Johnson. London: G. G. Harrap. 1914. Size 7½ × 5, pp. 282. *Sketch-maps and Illustrations. Price* 1*s.* 9*d. Presented by the Publishers.*

Canada—Ethnology. *B.G.S. Philadelphia* **12** (1914): 47–69. **Wheeler.**

The Dog-Rib Indian and his Home. By David E. Wheeler. *Illustrations and Sketch-map.*

Canada—Levelling. **Reid.**

Department of the Interior, Canada. Publications of the Dominion Observatory, Ottawa. Vol. 1, No. 8. Precise levelling. By F. B. Reid. Ottawa, 1914. Size 11½ × 9, pp. 209–258. *Maps.*

Canada—Nova Scotia. *B. American G.S.* **46** (1914): 413–419. **Whitbeck.**

A geographical study of Nova Scotia. By R. H. Whitbeck.

Canada and Alaska—Yukon. *Scottish G. Mag.* **30** (1914): 337–356. **Cadell.**

The Klondike and Yukon goldfield in 1913. By H. M. Cadell. *Illustrations, Sections, and Diagram.*

Based on a visit in connection with the International Geological Congress of 1913.

North America—Discovery. *M. k.k. G. Ges. Wien* **57** (1914): 239–249. **Kolischer.**

Zur Entdeckungsgeschichte Amerikas. Die Normannen in Amerika vor Columbus. Eine kritische Studie. Von Dr. Karl Arthur Kolischer.

United States—California. *B. American G.S.* **46** (1914): 420–426. **Holway.**

The effect of seven years' erosion on the California fault-line of 1906. By Ruliff S. Holway. *Illustrations.*

United States—California. *Univ. of California Publ. in G.* (1914): 307–330. **Holway.**

Preliminary Report on the recent Volcanic Activity of Lassen Peak. By Ruliff S. Holway. *Plates.*

See Monthly Record, *supra.*

United States—California—Salton sea. **Macdougal.**

The Salton Sea. A Study of the geography, the geology, the floristics, and the ecology of a desert basin. By D. T. Macdougal and collaborators. Washington, 1914. Size 15 × 9, pp. vii. and 182. *Maps and Illustrations.*

United States—Climate.

Climatological Data for the United States by Sections. Vol. 1, Nos. 1–3, January to March, 1914. (U.S. Department of Agriculture, Weather Bureau.) Washington, D.C., 1914. Size 12 × 8½. [Each section paged separately.] *Maps.*

The monthly data for the several sections, hitherto published separately, are now brought together in one issue.

United States—Coast and Geodetic Survey. **Showalter.**

National G. Mag. **25** (1914): 655–677.

Our Guardians on the Deep. By William Joseph Showalter. *Illustrations.*

United States—Dakota. *U.S. Geol. Surv. B.* **575** (1914): pp. 50. **Calvert and others.**

Geology of the Standing Rock and Cheyenne River Indian reservations, North and South Dakota. By W. R. Calvert, A. L. Beekly, V. H. Barnett, and M. A. Pishel. *Maps and Illustrations.*

United States—Kentucky—Cave. *Spelunca* **9** (1913): No. 73, pp. 50. **Hovey and Call.**

Bibliographie, chronologique et analytique, de Mammoth Cave, Kentucky. 1815 à 1914. Par Horace Carter Hovey et Richard Ellsworth Call.

United States—Levelling. **Coast and Geodetic Survey.**

Department of Commerce. U.S. Coast and Geodetic Survey. Hypsometry. Special publication No. 18. Fourth general adjustment of the precise level net in the United States and the resulting standard elevations. By William Bowie and H. G. Avers. Washington, 1914. Size 11½ × 9, pp. 328. *Sketch-map and Illustrations.*

United States—Maryland. *U.S. Geol. Surv., Prof. Paper* 90 B. (1914): pp. 16. **Hunter.**

Erosion and sedimentation in Chesapeake Bay around the mouth of Choptank river. By J. Fred. Hunter. *Sketch-map.*

United States—Maryland—Fisheries. **Yates.**

Survey of oyster bars of Maryland, 1906–1912. By Charles Yates. Published by Maryland Shell Fish Commission, U.S. Bureau of Fisheries, and U.S. Coast and Geodetic Survey. Washington, 1906–1913. Size 12 × 7½, pp. [1522]. *Maps. Also separate Atlas of maps, size* 33 × 23.

This bulky publication includes, bound in one volume, a series of separately paged memoirs, including (1) A general summary of the work and methods of the Maryland Oyster Survey (probably the most detailed yet undertaken anywhere) and the conclusions to be drawn from it; (2) detailed description, by counties, of the boundaries of the oyster bars and the triangulation stations in reference to which they are defined. Besides the special charts, there is an index chart to the same, supplying at the same time a graphical summary of the results of the six years' operations of the Survey.

United States—Massachusetts. *B.G.S. Philadelphia* **12** (1914): 70–79. **Harshberger.**

The vegetation of Nantucket. By John W. Harshberger. *Sketch-map and Illustrations.*

United States—New York. **Fuller.**

U.S. Geol. Surv., Prof. Paper **82** (1914): pp. xvi. and 232.

The geology of Long Island, New York. By Myron L. Fuller. *Maps, Sections, and Illustrations.*

United States—Oklahoma—Geology. *U.S. Geol. Surv. B.* **547** (1914): pp. 84. **Munn.**

Reconnaissance of the Granfield district, Oklahoma. By Malcolm J. Munn. *Maps, Diagrams, and Illustrations.*

United States—South-East. *J.G.* **12** (1914): 301–307. **Smith.**

Geographic Control of Transportation in the South-east. By John E. Smith. *Sketch-map.*

United States—Wyoming. *U.S. Geol. Surv. B.* **543** (1914): pp. 142. **Schultz.**

Geology and geography of a portion of Lincoln county, Wyoming. By Alfred Reginald Schultz. *Maps, Sections, and Illustrations.*

United States—Yosemite. *Popular Sc. Monthly* **85** (1914): 69–82. **French.**

Genesis and Revelations of the Yosemite Valley. By Harold French. *Illustrations.*

CENTRAL AND SOUTH AMERICA.

Brazil—North. **Buley.**

South American Handbooks. North Brazil: physical features, natural resources, means of communication, manufactures and industrial development. By E. C. Buley. London: Sir I. Pitman, 1914. Size 9 × 5½, pp. 216. *Maps and Illustrations. Price.* 6*s. net. Presented by the Publishers.*

Brazil—South. **Buley.**

South American handbooks. South Brazil: physical features, natural resources, means of communication, manufactures and industrial development. By E. C. Buley. London: Sir I. Pitman, 1914. Size 9 × 5½, pp. 220. *Maps and Illustrations. Price* 6*s. net. Presented.*

Colombia. *B. Min. Relaciones Exteriores, Colombia* **5** (1913): 409–433. **Nieto.**

Oficina de Longitudes. Informe de la Cuarta Expedicion. Por Garzón Nieto. *Illustrations.*

Reports on field-work for the determination of geographical co-ordinates principally in Cundinamarca and the region of the lower Magdalena (cf. *Journal*, vol. **38**, p. 533).

Patagonia—Ethnology. **Skottsberg.**

Observations on the Natives of the Patagonian Channel Region. By Carl Skottsberg. (Reprinted from the *American Anthropologist* (N.S.), vol. **15**, No. 4, October —December, 1913.)

Strait of Magellan—Historical. *Riv. Chilena. Hist. y G.* **6** (1913): 343–395. **Medina.**

El viaje de Ercilla al Estrecho de Magallanes. Par J. T. Medina.

AUSTRALASIA AND PACIFIC ISLANDS.

Australia—Hydrology. *P.R.S. Queensland* **25** (1914): 25–36. **Parker.**

Underground waters. (With special reference to South Australia and Queensland.) By Thomas Parker.

Easter island. *Riv. Chilena Hist. y G.* **9** (1914): 95–105. **Knoche.**
Algunas observaciones à la geomorfología de la Isla de Pascua. Por Walter Knoche.

Hawaii. *M.G. Ges. Wien* **57** (1914): 59–87. **Diener.**
Einiges über die Hawaiischen Inseln und den Kilauea. Von Dr. C. Diener. *Illustrations.*

Hawaii—Volcanoes. **Jaggar.**
Special Bulletin of Hawaiian Volcano Observatory. Scientific work on Hawaiian volcanoes. An address by T. A. Jaggar. [Honolulu], 1913. Size 9 × 6, pp. 16.

New Guinea—German. **Schultze.**
M. Deuts. Schutzgebieten, Ergänzgeht. **11** (1914): Pp. IV. and 99.
Forschungen im Innern der Insel Neuguinea. (Bericht des Führers über die wissenschaftlichen Ergebnisse der deutschen Grenzexpedition in das westliche Kaiser-Wilhelmsland 1910.) Von Dr. Leonhard Schultze. *Maps and Illustrations.*

New South Wales—Botany Bay. **Halligan.**
J. and P.R.S. New South Wales **47** (1913): 120–129.
The Physiography of Botany Bay. By G. H. Halligan. *Maps.*

New Zealand. **Capra.**
La Nuova Zelandia. Il paese dei Maori. Del Rev. Dott. Giuseppe Capra. Turin, 1913. Size 9 × 6, pp. 312. *Sketch-map and Illustrations. Presented by the Author.*

POLAR REGIONS.

Antarctic. *Sitzb. K. Preussischen A. W.* (1914): 50–69. **Penck.**
Antarktische Probleme. Von Albrecht Penck.

Antarctic—Expedition. *Ymer* **34** (1914): 17–33. **Palander and Nordenskjöld.**
Plan för en Svensk—Engelsk sydpolarexpedition. Af L. Palander and Otto Nordenskjöld. *Sketch-map.*
A summary of the plan here detailed was given in *Geog. Journal*, vol. **43**, p. 554.

Antarctic—Geology. *Cairo Sc. J.* **8** (1914): 77–82. **Ferrar.**
Notes on the Geology of the Antarctic Regions. By H. T. Ferrar. *Maps.*

Antarctic—Meteorology. *Quarterly J.R. Meteor. S.* **40** (1914): 221–227. **Simpson.**
Chief results of the Meteorological Observations made on Captain Scott's British Antarctic (Terra Nova) Expedition, 1911 and 1912. By Dr. G. C. Simpson.

Spitsbergen. *La G., B.S.G. Paris* **29** (1914): 313–317. **Stoll.**
Exploration entre la Van Mijens bay et l'Agardh bay (Spitsberg.) Expedition sous le patronage de S.A.S. le Prince de Monaco. Par Hermann Stoll. *Sketch-map and Illustrations.*
A summary of this narrative was given in vol. **43**, p. 584.

MATHEMATICAL GEOGRAPHY.

Surveying. **Corbin.**
La Stéréoautogrammetrie. Par Paul Corbin. (From *Rev. Générale des Sci.*, 30 Mars, 1914.) Paris, 1914. Size 12 × 8, pp. 223–252. *Maps and Illustrations.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Climatology. *Scottish G. Mag.* **30** (1914): 356–369. **Wallis.**
Geographical aspects of climatological investigations. By B. C. Wallis. *Sketch-maps and Diagrams.*

Climatology. **Whitehouse.**
Suggestions for a Course in Climatology in correlation with Geography. By Wallace E. Whitehouse. With preface by Dr. W. N. Shaw. Aberystwyth, [1914]. Size 10 × 6, pp. 31. *Price* 1*s.*

Climatology—Droughts. **Eredia.**
Sulla ripartizione della secchezza. Nota di Filippo Eredia. (Dalla *Revista Meteorico-Agraria*, Anno 35, N. 2.) Rome, 1914. Size 10½ × 7½, pp. 14.

Earth-movements. *J.G.* **22** (1914): 315–345. **Chamberlin.**
Diastrophism and the formative processes. VII. Periodicity of Paleozoic orogenic movements. By Rollin T. Chamberlin.

Geology—Age of the Earth. *Sc. Progress* **9** (1914): 37–54. **Joly.**
The Birth-Time of the World. By Prof. J. Joly.

Geology—Age of the Earth. *Sc. Progress* **9** (1914): 55–59. **Shelton.**
Sea-salt and Geologic Time. By H. S. Shelton.

Geology—Sediments. *J.G.* **22** (1914): 420–436. **Trowbridge.**
Studies for students: A classification of common sediments and some criteria for identification of the various classes. By Arthur C. Trowbridge. *Illustrations.*

Geomorphology. *G.Z.* **20** (1914): 129–145. **Hettner.**
Die Entwickelung der Landoberfläche. Von Alfred Hettner.

Geomorphology. *Beiträge z. Geophysik* **13** (1914): 164–181. **Scott.**
The spacing of Fracture systems and its influence on the Relief of the Land. By Dr. Irving Scott.

Geomorphology—Frost action. **Högbom.**
B. Geol. I. Univ. Upsala **12** (1914): 257–390.
Ueber die geologische Bedeutung des Frostes. Von Bertil Högbom. *Illustrations.*

Geomorphology—Landslides. *La G., I.G. De Agostini* **2** (1914): 82–93. **Michieli.**
Il fenomeno delle frane e la sua importanza. By Adriano Michieli.

Geophysics. *J.G.* **22** (1914): 289–314. **Barrell.**
The Strength of the Earth's Crust. IV. Heterogeneity and Rigidity of the Crust as measured by departures from Isostasy. By Joseph Barrell.

Limnology. *Beiträge z. Geophysik* **13** (1914): 306–337. **Halbfass.**
Moderne Aufgaben der geographischen Seenforschung. Von W. Halbfass.

Magnetism. *B. American G.S.* **46** (1914): 481–499. **Bauer.**
The General Magnetic Survey of the Earth. By L. A. Bauer. *Maps and Illustrations.*

Meteorology—Rainfall. *B. American G.S.* **46** (1914): 321–335. **Douglass.**
A Method of estimating Rainfall by the Growth of Trees. By A. E. Douglass. *Diagrams.*

Oceanography—Currents. *Annalen Hydrographie* **42** (1914): 379–391. **Thorade.**
Die Geschwindigkeit von Triftstromungen und die Ekmansche Theorie. Von Dr. H. Thorade.

Oceanography—Light absorption. **Grein.**
Untersuchungen über die Absorption des Lichts im Seewasser. (Zweiter Teil.) Von Klaus Grein. (*Annales de l'Institut Océanographique*, Tome VI. Fasc. 6.) Paris: Masson et Cie., 1914. Size 13 × 10, pp. 21. *Illustrations.*

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Anthropogeography. *B.R.S.G. Madrid* **56** (1914): 7–45. **Sereix and Taibo.**
Atractividad geografica. Por R. A. Sereix y L. P. Taibo.
On the reasons determining suitability of regions for civilization, and the location of town sites.

Disease—Sleeping sickness.
Sleeping-Sickness Committee. Minutes of evidence taken by the Departmental Committee on Sleeping Sickness. London, 1914. Size 13 × 8¼, pp. iv. and 330. *Price* 2*s.* 8*d.*

Economic—Tropical rain. *Ann. G.* **23** (1914): 109–126. **Capus.**
La valeur économique des pluies tropicales. Par Guillaume Capus. *Diagrams.*

Glaciation and agriculture. **von Engeln.**
B. American G.S. **46** (1914): 242–265, 336–355.
Effects of Continental Glaciation on Agriculture. By O. D. von Engeln. *Sketch-maps and Illustrations.*
Noticed in the Monthly Record, *supra.*

Historical—Balboa. **Beltrán y Rózpide and others.**
B.R.S.G. Madrid **55** (1913): 409–434.

Vasco Núñez de Balboa y el Descubrimento del Mar del Sur. Discursos que se dijeron ó leyeron en la Sesión extraordinaria celebrada por la Real Sociedad Geográfica el 25 de Septiembre de 1913 para commemorar, en el día de su cuarto centenario, el descubrimento del Océano Pacífico. By Ricardo Beltrán y Rózpide, Manuel de Saralegui, Angel de Altolaguirre, Rafael Conde y Luque, Juan B. Sosa, Adolfo de Motta, and Marcelo de Azcárraga.

Historical—Cartography. **Wolkenhauer.**

Aus der Geschichte der Kartographie. Das Zeitalter des Uebergangs, 1600 bis 1750. Von W. Wolkenhauer. (Aus den *Deutschen Geographischen Blättern*, Bd. 36, 1913.) Bremen, 1913. Size 9 × 6, pp. 136–158.

Historical—Pytheas. **Sphyris.**

Const. D. Sphyris. Contribution to the history of discoveries. Pytheas the Massaliot. Athens, 1912. Size 8½ × 6, pp. 136. [In Greek.]

Historical—Voyage. **Mazarredo.**
B.R.S.G. Madrid **55** (1913): 67–199, 470–503; **56** (1914): 90–104.

Noticia de la navegacion de la fragata de guerra titulada "Santa Rosalia" en el año de 1774. Extracto del Diario . . . hecho por el Ten. José de Mazarredo.

Population. *B. American G.S.* **46** (1914): 401–413. **Jefferson.**

Population estimates for the countries of the World for 1914 to 1920. By Mark Jefferson. *Diagrams.*

BIOGRAPHY.

Murray. **Mill.**

The late Sir John Murray, K.C.B., F.R.S. By Hugh Robert Mill. (Reprinted from *British Rainfall*, 1913.) *Portrait.*

GENERAL.

British Empire—Timber. *United Empire* **5** (1914): 469–476. **Grice.**

The Timber Resources of the Empire. By J. Watson Grice.

Dutch Colonies—Ethnology. **Van Eerde.**

Koloniaal Instituut te Amsterdam. Mededeeling No. 1. Afdeeling Volkenkunde No. 1. Koloniale Volkenkunde door J. C. Van Eerde. Eerste Stuk: Omgang met Inlanders. Amsterdam, 1914. Size 9 × 6, pp. 182. *Illustrations.*

Education. *G. Teacher* **7** (1914): 215–227. **Keltie.**

Thirty years' progress in geographical education. By Dr. J. Scott Keltie.

Educational. *J.G.* **12** (1914): 333–340. **Ridgley.**

The Problem of Place Geography. By Douglas C. Ridgley.

French Colonies—Historical. *Rev. Hist. Colonies Françaises* **2** (1914): 77–104. ——

L'Histoire des Colonies Françaises à l'Exposition cartographique de la Bibliothèque nationale. Par H. F.

Geography. *Scot. G. Mag.* **30** (1914): 467–480. **Brown.**

The Province of the Geographer. By R. N. Rudmose Brown.
Lecture at Sheffield University.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

British Isles—England and Wales. **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, from September 1 to 30, 1914.

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London Agents: E. Stanford, Ltd.; Sifton, Praed, & Co.

Europe. **Bartholomew.**

Bartholomew's Reduced Survey Map of North-Eastern France, Belgium, and the Rhine. Scale 1 : 1,000,000 or 1 inch to 15·78 stat. miles. Size 21 by 29 inches. Edinburgh: John Bartholomew & Co., [1914]. *Price* 3*s. mounted on cloth. Presented by the Publishers.*

Shows relief effectively by means of the colour layer system at the following contour intervals, in metres: 0–100, 100–200, 200–300, 300–400, 400–600, 600–800, 800–1000, 1000–1500, 1500–2000, and above 2000. Railways, fortresses, main, secondary, and other roads, and custom houses are also given, while figures along the roads indicate the distance between road junctions and places.

Europe. **Bartholomew.**

General map showing European Frontiers, 1914. Scale 1 : 2,000,000 or 1 inch to 31·56 miles. Size 22 by 34 inches. Edinburgh: John Bartholomew & Co., [1914]. *Price* 2*s. net, mounted on cloth. Presented by the Publishers.*

Europe. **Bartholomew.**

General map showing European Frontiers, 1914. Scale 1 : 5,448,960 or 1 inch to 86 stat. miles. Size 18 by 24 inches.—Frontier Regions between France, Germany, Belgium, and Holland. Scale 1 : 2,000,000 or 1 inch to 31·56 stat. miles. Size 16 by 22 inches. Edinburgh: John Bartholomew & Co., [1914]. *Price* 2*s. net, mounted on cloth. Presented by the Publishers.*

Europe. **Geographical Section, General Staff.**

Skeleton map of Western Europe. Scale 1 : 500,000 or 1 inch to 7·89 stat. miles. 8 sheets, each 21 by 28 inches.—Skeleton map of Central Europe. Scale 1 : 750,000 or 1 inch to 11·8 stat. miles. 6 sheets, each 26 by 30 inches. Geographical Section, General Staff, War Office, August, 1914. London Agents: E. Stanford, Ltd.; Sifton, Praed, & Co.; T. Fisher Unwin. *Price* 1*s. net, each sheet. Presented by the Director of Military Operations.*

These sheets have been specially prepared for the purpose of laying down the routes followed by armies, and general movements of troops, during the present war. No attempt has been made to show relief, and all they contain are the more important places and railways in black, rivers and lakes in blue, principal roads in black, and fortresses and international boundaries in red.

Europe. **Philip.**

Daily Mail General War Map of Europe. Scale 1 : 5,385,600 or 1 inch to 85 stat. miles. *Price* 6*d.*—*Daily Mail* larger-scale Military Maps: 1, the Franco-Belgian and German Frontiers, scale 1 : 728,540 or 1 inch to 11·5 stat. miles; 2, the Austro-German and Russian Frontiers, scale 1 : 1,457,280 or 1 inch to 23 stat. miles; 3, the Franco-Belgian Theatre of War, scale 1 : 728,540 or 1 inch to 11·5 stat. miles. *Price* 3*s. each.* London: George Philip & Son, Ltd., 1914. *Presented by the Publishers.*

Europe. **E. Stanford.**

The Franco-German Frontier and Western Germany. Stanford's War Maps, No. 4. Scale 1 : 1,140,480 or 1 inch to 18 stat. miles. Size 34 by 24 inches. *Price* 5*s.* The Seat of War in Belgium. Stanford's War Maps, No. 6. Scale 1 : 380,160 or 1 inch to 6 stat. miles. Size 29 by 39 inches. *Price* 5*s.* The Seat of War in France. Stanford's War Maps, No. 7. Scale 1 : 1,140,480 or 1 inch to

18 stat. miles. Size 20 by 28 inches. *Price* 2*s.* 6*d.* London: Edward Stanford, Ltd., 1914.

Three maps useful at the present time for following the events of the war. Boundaries are shown in colour.

France. **Frater.**

Carte de la Frontière Nord-Est de la France par le Colonel Frater. 14e Edition (1914). Scale 1:864,000 or 1 inch to 13·6 stat. miles. Size 22 by 23 inches. Paris: Chapelot & Cie., 1914.

This is a new edition of a map showing the whole of the French frontier, with the adjacent territories, from the coast to just south of Belfort. It is clearly printed in colours; and by various symbols considerable information is given concerning railways, roads, canals, fortresses, and the relative importance of towns. A somewhat full and interesting note is given at the side of the map descriptive of the frontier in its various sections, and military matters connected with it.

ASIA.

Ceylon. **Survey Dept., Colombo.**

Ceylon. Scale 1:253,440 or 1 inch to 4 stat. miles. 4 sheets, each 36 by 24 inches. Colombo: Survey Department, 1914.

As was the case with the previous map of the island on the same scale, issued by the same department, no attempt of any kind has been made to show relief either by contours or shading, and no figures of altitudes are given. However, there is much new information relative to the courses of rivers, roads, lakes, etc., from recent surveys. The map is printed in colours.

China. **Audemard.**

Mission Audemard. Chine. Haut Yang-tseu et Yalong. Levé exécuté en 1910 par M. Audemard, Capitaine de Frégate. Atlas de 37 feuilles a l'échelle de 1:37,500 (1·7 inch to 1 stat. mile) et d'une feuille d'assemblage. Paris: Service Hydrographique de la Marine, 1914. *Price* 24 *fr. Presented by the Ministère de l'Instruction Publique et des Beaux Arts, Paris.*

A large portfolio of charts of the courses of the Yangtze and Yalong above Swifu, from surveys executed in 1910 by Captain Audemard, of the French navy. From the confluence of the Yalong to above the bridge at Tsu-li-kiang, the charts are the result of surveys made both in going up and coming down the river; but the other parts from the confluence of the Yalong to Suifu and the Yalong depend only upon a survey made in the descent. The charts show the river as it exists at low water, but the high-water level is indicated by shading in hachures on the sides of the cliffs and banks. The land relief adjacent to the river is shown by horizontal form lines, and figures give soundings and heights, the latter being determined by aneroid and clinometer. Latitudes and longitudes of places from astronomical observations, are clearly stated, and to these positions the compass survey has been adjusted. In the transliteration of the Chinese place-names the system of the Ministère des Affaires Etrangères has been adopted, and under the names of the villages on the chart figures are given showing, as far as possible, the number of families. Numerous interesting profile sketches appear on the sheets, and altogether the work has been very satisfactorily carried out.

The sections of the rivers covered by these charts were included in the atlas published in 1913, from the surveys of the same expedition, and noticed in the *Geographical Journal* for November, 1913; but those now published are on a larger scale, and are much more complete.

India. **Surveyor-General of India.**

Maps published by the Survey of India during the quarter ending June 30, 1914. Miscellaneous maps, scale 1 inch to 1 mile, Mandalay and surrounding country. District maps, scale 1 inch to 4 miles, Bhagalpur. India and adjacent countries, Southern Asia Series, scale 1:2,000,000, sheets: Northern Persia, Southern Persia. India and adjacent countries, scale 1:1,000,000, sheets (provisional issue) 41, 56. Degree sheets, scale 1 inch to 4 miles, Assam and Bengal, sheet 78–L (provisional issue); Assam and Bhutan, sheet 78–J (provisional issue); Bengal, sheet 79–C; Bengal and Bihar and Orissa, sheet 78–C (provisional issue); Bhutan, Bengal, and Assam, sheet 78–F (provisional issue); Bihar and Orissa, Central Provinces and United Provinces, sheet 64–M (provisional issue); Bihar and Orissa and United Provinces, sheet 63–N (provisional issue); Bombay and Central India, sheet 46–K; Madras, sheet 49–N. Standard maps, scale 1 inch to 1

mile. Assam, sheets 78–N 13, 83–B 1; Bihar and Orissa, sheets 63–P 9 (preliminary edition, with village boundaries), 72–G 10 and 14 (145) (second preliminary edition), 73–B 9, 73–B 13, 73–E 4 (preliminary edition), 73–E 8 (preliminary edition); Burma, sheets 92–G 11, 94–D 9 and 13 (309), 95–J 7; Central India and Central Provinces, sheet 54–L 4; Madras, sheets 48–P 1, 48–P 2, 48–P 5, 58–C 1 and 5, 58–C 9; Madras and Mysore, sheets 48–O 4, 48–P 9; Punjab, sheets 44–I 10, 44–I 13, 44–I 15, 44–M 1, 44–N 2. Calcutta: Map Record and Issue Office, Survey of India. *Presented by the Surveyor-General of India.*

AFRICA.

Africa. **E. Stanford.**

Stanford's Library Map of Africa. Scale 1: 5,977,382 or 1 inch to 94·34 stat. miles. 4 sheets, each 29 by 32 inches. London: Edward Stanford, Ltd., 1914. *Price* 35*s*. *Presented by the Publishers.*

A new edition of this well-known large general map of Africa. A great deal of revision has been done, and careful attention has been paid to boundaries, railways, etc., to bring them up to date.

Nigeria, Southern. **Guggiebsrg.**

Africa. Scale 1: 125,000 or 1 inch to 1·97 stat. miles. Southern Nigeria. Sheets: North B 31–E I. Iwo, revised to May, 1913; North B 31–E II., Ilesha, revised to June, 1913. Size 18 by 18 inches. 1st edit. Published under the authority of Sir Frederick Lugard, G.C.M.C., C.B., D.S.O., Governor, under the direction of Major F. G. Guggisberg, C.M.G., R.E., Director of Surveys, Southern Nigeria, and Captain R. H. Rowe, R.A., Deputy Director, Topographical Branch. Engraved and printed by Messrs. W. & A. K. Johnston, Ltd., Edinburgh and London. *Price* 1*s*. 6*d*. *each sheet. Presented by Messrs. W. & A. K. Johnston, Ltd.*

Tripoli. **Ministero delle Colonie.**

Cirenaica. Scale 1: 400,000 or 1 inch to 6·3 stat. miles. Sheet 1. Size 17 by 26 inches. Rome: Ministero delle Colonie, Direzione Generale degli Affari Politici, 1914. *Presented by the Ministro delle Colonie, Rome.*

Based chiefly on the route traverses made during recent Italian military operations. From the style of production it appears to be a preliminary sketch, with routes in red, water blue, and relief indicated by brown vertical hachures.

Tripoli. **Ministero delle Colonie.**

La Conca di Ommerzem. Scale 1: 25,000 or 2·5 inches to 1 stat. mile. Size 8 by 10 inches. Rome: Ministero delle Colonie, Direzione Generale degli Affari Politici, 1914. *Presented by the Ministro delle Colonie, Rome.*

Tripoli. **Ministero delle Colonie.**

Schizzo dimostrativo della Tripolitania Settentrionale. Scale 1: 400,000 or 1 inch to 6·3 stat. miles. Sheets: III., Nalut-Ghadames; IV., Giado-Misda. Size 25 by 19 inches. Rome: Ministero delle Colonie, Direzione Generale degli Affari Politici, 1914. *Presented by the Ministro delle Colonie, Rome.*

Black and white sketch-maps, based on the route traverses of Italian officers made during the recent military operations, combined with other information.

Tripoli. **Ministero della Colonie.**

Schizzo dimostrativo della Regione Sirtica. Scale 1: 1,000,000 or 1 inch to 15·78 stat. miles. Size 15 by 24 inches. Rome: Ministero delle Colonie, Direzione Generale degli Affari Politici, 1914. *Presented by the Ministro delle Colonie, Rome.*

AMERICA.

Canada. **Dept. of Mines, Geological Survey.**

Geological Survey of Canada. Map 97 A, Franklin Mining Camp, West Kootenay, B.C., scale 1: 24,000 or 2·6 inches to 1 stat. mile, size 11 by 11 inches; 119 A, Willowbunch Coal Area, Saskatchewan, scale 1: 253,440 or 1 inch to 4 stat. miles, size 11 by 16 inches; 133 A, Mineral Claims, Franklin Mining Camp, West Kootenay, B.C., scale 1: 31,680 or 2 inches to 1 stat. mile, size 9 by 9 inches. Ottawa: Department of Mines. Geological Survey, 1914. *Presented by the Department of Mines, Geological Survey, Ottawa.*

Canada. **Dept. of the Interior, Ottawa.**

Sectional map of Canada. Scale 1 : 190,080 or 1 inch to 3 stat. miles. Sheets: 20, Souris, Saskatchewan, revised to May 1, 1914; 364, Fort Assiniboine, Alberta, revised to June 1, 1914; 413, Iosegun, Alberta, revised to June 1, 1914. Ottawa: Department of the Interior, Topographical Surveys Branch, 1914. *Presented by the Department of the Interior, Ottawa.*

Canada. **Dept. of the Interior, Ottawa.**

Cereal Maps of Alberta and Saskatchewan, showing acreage under crop in each township in wheat, oats, barley, and flax. Scale 1 : 792,000 or 1 inch to 12·5 stat. miles. Prepared in the Railway Lands Branch under the direction of F. C. C. Lynch, Superintendent, from data supplied by the Provincial Government and the Census Branch, Department of Trade and Commerce. Crop 1913. Third edition, 1914. Ottawa: Department of the Interior, Railway Lands Branch, 1914. *Presented by the Department of the Interior, Railway Lands Branch, Ottawa.*

Canada—British Columbia. **Dept. of Lands, B.C.**

Pre-Emptor's Map. Scale 1 : 190,080 or 1 inch to 3 stat. miles. No. 39, Quesnel, revised to July 1, 1914. Victoria, B.C.: Department of Lands, 1914. *Presented by the Surveyor-General of British Columbia.*

A diagrammatic map, showing lands open to pre-emption coloured red, lands in University reserve coloured blue, and lands reserved for public auction coloured light blue.

Central America. **Appleton.**

Mapa de América Central. Publicado por D. Appleton y Cia. Nueva York. Scale 1 : 1,705,000 or 1 inch to 26·8 stat. miles. New York: The Ohman Map Co., 1914.

As regards topographical features this map remains much as it was in the earlier edition, but corrections have been made to railways to bring them up to date. Considerable changes have been made in the eastern and western boundaries of Honduras.

AUSTRALIA.

Queensland. **Dept. of Public Lands, Brisbane.**

Plan of the City of Brisbane and Suburbs according to the original Crown Grants. Scale 1 : 6336 or 10 inches to 1 stat. mile. Size 40 by 30 inches. Brisbane: Department of Public Lands, 1914.

Western Australia. **Dept. of Lands and Surveys, Perth.**

Map of Western Australia. Scale 1 : 584,000 or 1 inch to 25 stat. miles. 4 sheets, each 33 by 22 inches. Perth: Department of Lands and Surveys, 1914. *Presented by the Surveyor-General of Western Australia.*

A new edition of a useful general map of Western Australia, with corrections and alterations to railways, boundaries of goldfields, and topographical features.

CHARTS.

Atlantic, North. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic Ocean, September, 1914. Washington: U.S. Hydrographic Office, 1914. *Presented by the U.S. Hydrographic Office.*

Atlantic, North, and Mediterranean. **Meteorological Office.**

Monthly Meteorological charts of the North Atlantic and Mediterranean, October, 1914. London: Meteorological Office, 1914. *Price 6d. each. Presented by the Meteorological Office.*

Indian Ocean. **Meteorological Office.**

Monthly Meteorological charts of the Indian Ocean, October, 1914. London: Meteorological Office, 1914. *Price 6d. each. Presented by the Meteorological Office.*

Indian Ocean. **U.S. Hydrographic Office.**

Pilot chart of the Indian Ocean, October, November, 1914. Washington: U.S. Hydrographic Office, 1914. *Presented by the U.S. Hydrographic Office.*

Pacific, North. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, October, November, 1914. Washington: U.S. Hydrographic Office, 1914. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

North America. **MacDougal.**

50 photographs of Western United States and Northern Mexico, taken by Prof. D. T. MacDougal, M.A., PH.D., 1904–1912. *Presented by Prof. D. T. MacDougal, M.A., Ph.D.*

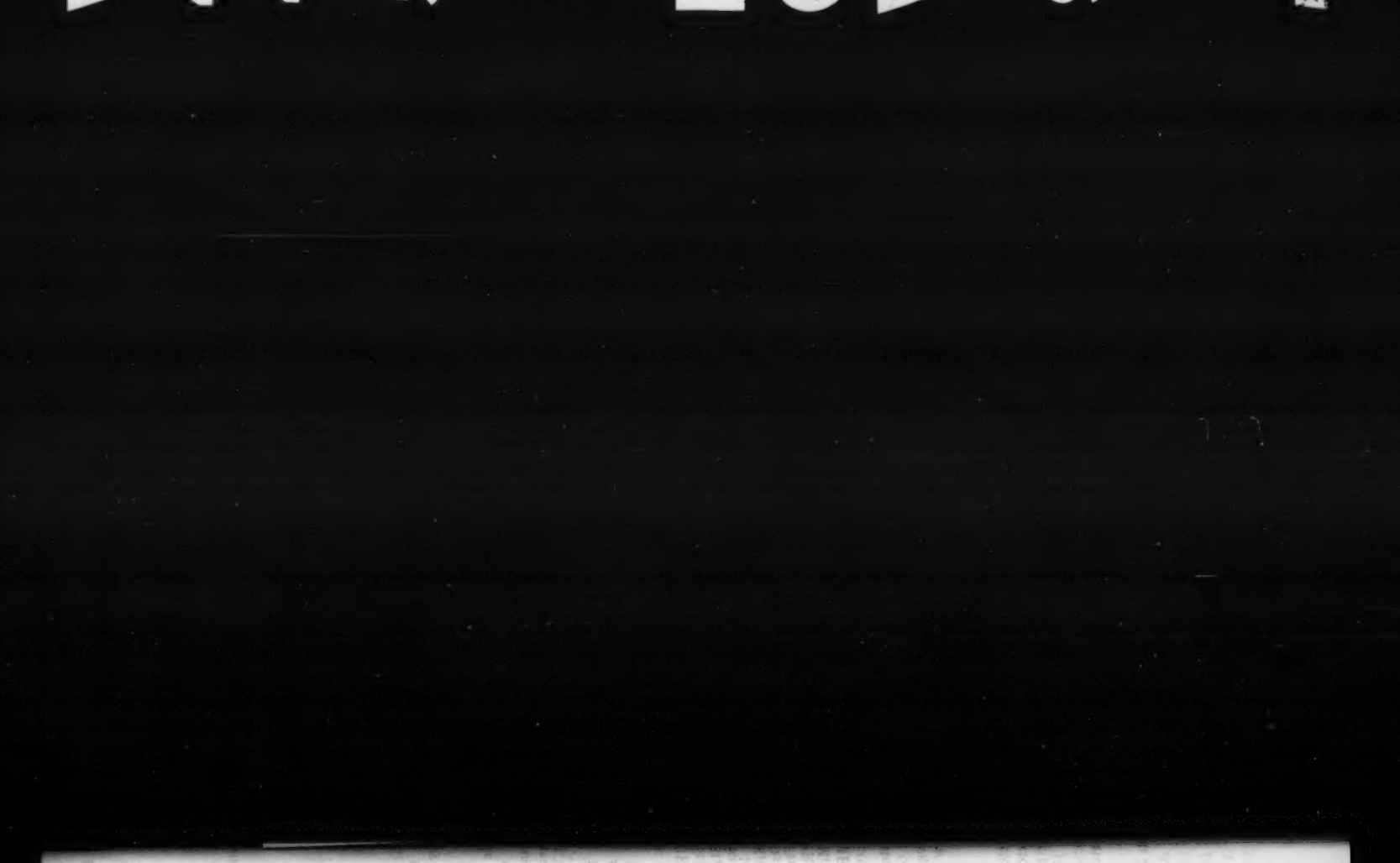
An excellent set of photographs, many of which are characteristic of the desert region described by Prof. MacDougal in the paper he read before this Society in December, 1911. They measure 6 by 8 inches.

(1) Scene in the Mohave desert; (2) Yucca tree in Mohave desert; (3) Southern part of San Joaquin valley, with cactus; (4 and 5) Neowashingtonia north of Indio; (6) Emersion of 1909 Salton near Mecca; (7) Emersion of 1910 Salton, 5 miles south of Mecca; (8) Emersion of 1910 Salton near Mecca; (9) Emersion of 1911 Salton near Mecca; (10) Flank of Travertine rock, Salton basin; (11) Beach ridge at high level above Travertine; (12) Travertine rock and wash, parosela in foreground; (13) View down Travertine wash towards Salton lake, showing ground inundated in 1907 now supporting a dense vegetation; (14) Ancient strands and margin of Salton south of Travertine rock; (15) Cut bank made by Salton sea at high level in 1906, Travertine terrace; (16) Travertine terrace, looking north; (17) Terrace made by Salton lake at highest level in 1907; (18) Island standing as small hill surrounded by fractured mud flats, south-west corner of Salton lake; (19) Indian granary, Salton region; (20) South-western corner of Salton sea, October, 1912, emergence of clay ridges; (21) First plant (*Sesuvium sessile*) on emerging island in Salton sea; (22) Hot springs near Winnemucca; (23) Sage brush near Winnemucca; (24) Cañon des Coches, Tortolitas mountains; (25) Sabina Cañon with exposure of gneissic rock, Toumey; (26) Pass to Sabina Cañon, Sta. Catalina mountains; (27) Rock in place, detrital slopes and wash, western end of Santa Catalina mountains; (28) Tanque Verde wash, Sta. Catalina mountains; (29) Papago stone houses, Arizona; (30) Papago brush house, Arizona; (31) Sonoyta; (32) Sonoyta creek; (33) Terminus of running stream of Sonoyta river; (34) Salada of Sonoyta river; (35) Northward from west end of Pinacate mountains; (36) Panorama of crater in Pinacate mountains; (37) Sykes crater, Pinacate mountains; (38) Papago tanks, Pinacate mountains; (39) Vegetation of arid plains of Sonora; (40) Mud volcanoes near western margin of the delta of the Colorado river; (41) Brush hut of Yaqui Indians, Sonora; (42) Panorama of flood plain near mouth of Colorado river; (43) Main channel of the Colorado river south of International boundary; (44) Island in Guaymas harbour, bearing cacti; (45) Main channel of the Hardy river where it touches the Cucopa mountains; (46) Looking down the Hardy river from spur of Cucopa mountains; (47) Looking down stream, Hardy river, from top of spur of Cucopa mountains; (48) Expedition of 1904, boat and rocky point at entrance to Bay San Felipe; (49) Boat party starting for climb of dry peaks from Bay San Felipe; (50) Water hole near shore, Bay San Felipe.

Togo. **Schomburgh.**

41 photographs of Togo taken by Major Hans Schomburgh. *Presented by Major Hans Schomburgh.*

Natives, their dwellings, and the characteristic features of the country are all represented in this set of photographs, which measure 5 by 7 inches.

(1) Native loom, Chanjo; (2) Chanjo horsemen crossing stream; (3) Uro Jabo, paramount chief of the Chanjo; (4) Iron furnaces at Banyeli; (5) Village of the Banyeli iron workers; (6) Iron from the furnace, Banyeli; (7) The chief of Banyeli; (8 and 9) Government station, Bassari; (10 and 11) Rest house at Bassari; (12) Bassari mountains; (13) River scene near Bassari; (14–18) River scene near Sokode; (19) River scene near Sokode, dry season; (20) Market at Sokode; (21) Children at Sokode; (22) Konkomba corn bin; (23) Konkomba village; (24) Konkomba village and fetish; (25–30) Konkomba warrior; (31) Fort built at Ibubu; (32) Native loom at Bafilo; (33) Cotton ginning and spinning; (34–36) Chokossi village, Mangu district; (37) Alejo Kardara in the mountains; (38) Camp near the Oti river north of Mangu; (39) Tamberma fort; (40) Chopowa rest-house, Konkomba country; (41) Natives gambling.

N.B.—It would greatly add to the value of the collection of Photographs which have been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.